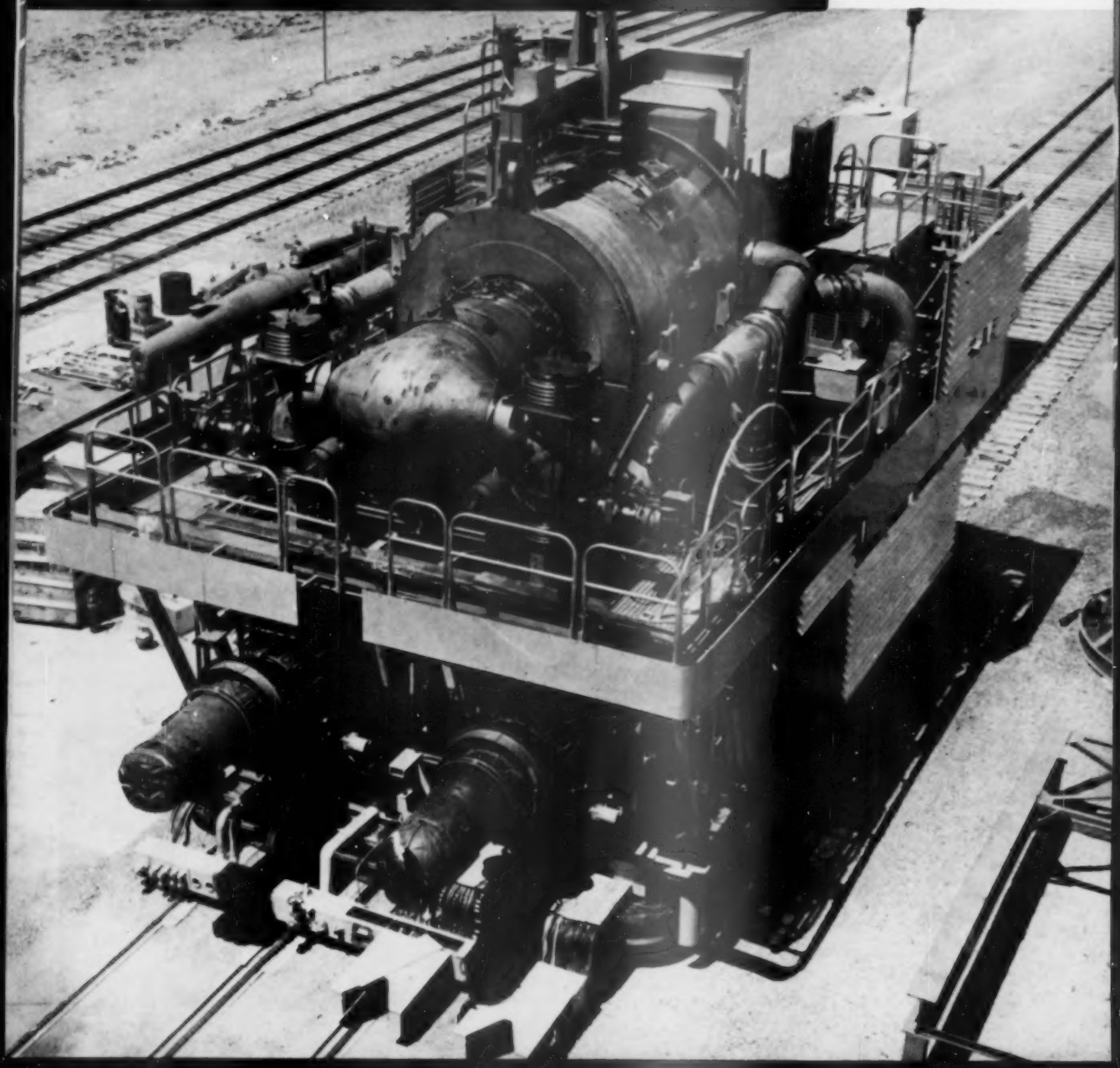
Aviation Week and Space Technology

February 22, 1960

Beech Speeds Plans For Turbine Planes

GE Jet Engine
Nuclear Reactor



CRYOGENIC TRANSFER PUMPS
for every GSE need
Centrifugal pumps, developed and produced by our Turbomachinery Division, handle hydrogen, oxygen, nitrogen, fluorine, and fluorides. Standard designs are immediately available, or can be adapted to meet special requirements for pumping any and all rocket propellants.
• Low Net Positive Suction Head offers advantage of pumping from unpressurized tanks, with significant large installation savings
• Capacities from 50 to 5500 gpm
• Pressure rises from 50 to 2000 psi
• Light wet-end weight, resulting in low boiloff during system cooldown
• Leakproof sealing systems for safely handling hazardous fluids
• Variable-speed electric motor pump drive for varying pump output requirements
Aerojet-General
CORPORATION
Plants at Azusa and near Sacramento, California
A SUBSIDIARY OF THE GENERAL TIRE AND RUBBER COMPANY
Engineers, scientists – investigate outstanding opportunities at Aerojet

HY V/L* fuel booster pumps provide higher reliability, are lighter in weight, and cost less.

Still *Another* Hydro-Aire Product for the *Aircraft* and *Missile* Industries

The Hydro-Aire fuel booster pump shown above is typical of a universally accepted family of pumps—known around the world—flown around the world. As used in jet fighters, bombers, and missiles, this pump is lighter—weighing only 6.8 pounds—is lower in cost, has proven much more reliable. It pumps 20,000 pounds of fuel per hour at 16 psig minimum. Ambient temperature range is −65°F to 250°F at sea level to 100,000 ft. altitude. These units consistently demonstrate excellent dry running, vapor and ice handling characteristics.

Attention: Fuel System Designers

Hydro-Aire can supply pumps, subsystems or systems to handle Avgas, JP fuel, water, alcohol, liquid nitrogen, liquid oxygen, hydraulic oil and engine oil. They can be supplied electric motor driven, hydraulic motor driven, engine driven or turbine driven.

Send your requirements or write for information.

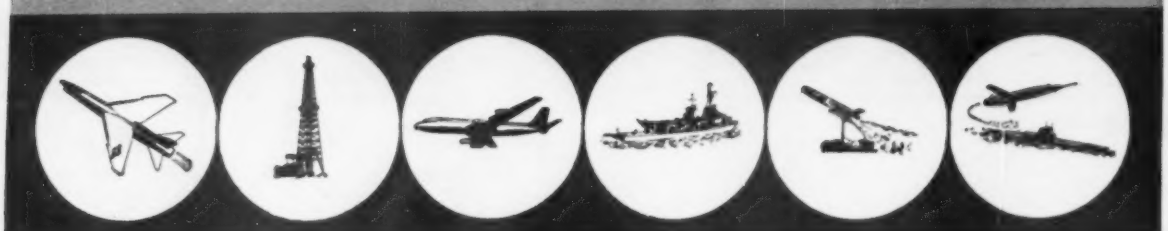
Engineers: Interesting opportunities are available. Write or call Mr. Douglas Nickerson, Chief Engineer, 3000 Winona Avenue, Burbank.

*high vapor/liquid ratio

HYDRO-AIRE
BURBANK, CALIFORNIA
Division of CRANE CO.
Developers and producers of reliable control components, sub-systems and systems for aircraft, missiles, electronics, transportation and general industry

SARGENT

SERVO-SYSTEMS OF FORCE CONTROL



With 38 years acceptance Sargent builds precision linear and rotary hydraulic, pneumatic, mechanical and electronic systems of force control to meet successfully the increasingly high requirements of marine, aircraft, missile, petroleum and industrial use. From original idea to finished product – SARGENT.

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"GOOD WILL" is the disposition of the pleased customer to return to the place where he has been well treated.
– U.S. Supreme Court

AVIATION CALENDAR

Mar. 7-8—Fifth Annual Business Aircraft Safety Seminar, Dearborn Inn, Dearborn. Sponsor: Flight Safety Foundation.

Mar. 9-10—Symposium on "Processing Materials for Re-Entry Structures," Miami Hotel, Dayton, Ohio. Sponsor: Midwest Chapter, Society of Aircraft Material & Process Engineers.

Mar. 9-11—Conference on the Mechanical Properties of Engineering Ceramics, North Carolina State College, Raleigh, N. C. Sponsors: North Carolina State College School of Engineering; Office of Ordnance Research, U. S. Army.

Mar. 10-11—National Flight Propulsion Meeting (classified Secret), Institute of the Aeronautical Sciences, Cleveland.

Mar. 14-15—Symposium on Load-Carrying Capacity of Bearings, American Society of Mechanical Engineers' Lubrication Division, Engineering Societies Building Auditorium, New York, N. Y.

Mar. 15—Defense Planning Seminar, Electronic Industries Assn., Statler-Hilton Hotel, Washington, D. C.

Mar. 17-18—Synchro Design and Testing Symposium, Department of Commerce Auditorium, Washington, D. C. Sponsor: Navy Dept., Bureau of Naval Weapons.

Mar. 21-24—Institute of Radio Engineers' International Convention, Waldorf Astoria and Coliseum, New York, N. Y.

Mar. 23-25—Symposium on Optical Spectrometric Measurement of High Temperatures, University of Chicago, Chicago, Ill. Sponsors: University of Chicago's Applied Science Laboratories; Jarrell-Ash Co.; National Science Foundation.

Mar. 23-25—Ground Support Equipment Conference, American Rocket Society, Statler-Hilton Hotel, Detroit, Mich.

Mar. 24-25—First Annual Symposium on Human Factors in Electronics, New York, N. Y. Sponsor: Institute of Radio En-

(Continued on page 6)

AVIATION WEEK and Space Technology

February 22, 1960

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Engineering notes from the

SMI REPORTER

By **STANLEY M. INGERSOLL**, *Capabilities Engineer*

Report No. 2 TS 539 Test Set

Our new TS 539 Test Set answers the demand for simple, fast and accurate means of flight line testing of air data computers and a universal test device for the generation of accurate pneumatic pressures in a wide variety of applications. The critical sensing element within our TS 539 is an SMI force balance pressure transducer of extreme sensitivity and accuracy.

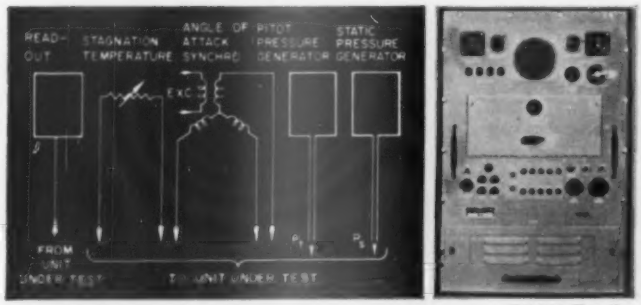
As two examples of widely different points in a typical flight envelope, the TS 539 generates pitot and static pressures to simulate an aircraft flying at Mach 0.8 at sea level to an accuracy of ±½ millimach with an altitude accuracy of ±7 feet; at a speed of Mach 3 at 70,000 feet, Mach accuracies are within ±5 millimachs and altitude accuracies are within ±90 feet.

The TS 539 also includes capability of simulating angle of attack and stagnation temperatures.

In the TS 539, a completely self-contained Precision Dual Pressure Generating System supplies the necessary inputs simulating the broadest range of flight conditions. Panel facilities are provided for read-out of selected signals and provision is made for routing of other signals to a digital multimeter. Comprehensive tests may be accurately and quickly performed by semi-skilled operators. Automatic and manual control is provided to select outputs which simulate conditions within aircraft flight envelopes. Unusual flexibility is inherent in this design that permits ready adaptation to any test requirement involving the need for precision control of pressure sources.

Typical Performance Specifications

Static Pressure, P_s	25 to 800 mm. Hg
Altitude, H_p	−1500 to 75,000 ft.
Total Pressure, P_t	50 to 1270 mm. Hg
Differential Pressure, Q_c	25 to 1020 mm. Hg
Stagnation Temperature, T_j	−20 to 120 Deg. C.
Angle of Attack, α_j	Full 360 Degrees



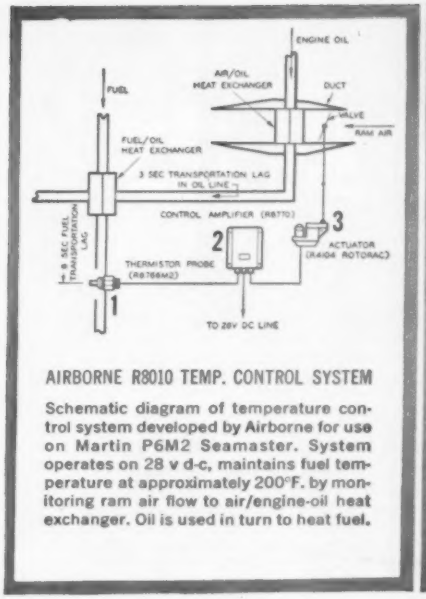
TS 539 Test Set

What are your needs? **If your requirements call for test equipment for accurate generation of pneumatic pressures, write or wire for complete information. Address your inquiries to Stanley M. Ingersoll, Capabilities Engineer.**

SMI

SERVOMECHANISMS, INC.

Los Angeles Division
12500 Aviation Boulevard
Hawthorne, California



AIRBORNE R8010 TEMP. CONTROL SYSTEM

Schematic diagram of temperature control system developed by Airborne for use on Martin P6M2 Seamaster. System operates on 28 v d-c, maintains fuel temperature at approximately 200°F. by monitoring ram air flow to air/engine-oil heat exchanger. Oil is used in turn to heat fuel.

Airborne electromechanical system regulates jet fuel temperature

An integral part of each main engine installation on the Martin P6M2 Seamaster is an Airborne R-8010 custom-engineered temperature control system. By regulating air flow through a heat exchanger, this system maintains supply line fuel at 180-220°F.

As developed for the P6M2, the R-8010 system consists of a thermistor probe, a control amplifier and a rotary actuator. The probe (mounted in an MS10057-12 fitting) is in direct contact with the temperature-regulated fuel and presents to the control box a resistance which is proportional to fuel temperature. In response, the control box energizes the actuator to change the setting of a ram air intake valve, thus regulating volume of air flow through an air/fuel heat exchanger. This sensing and response continues until prescribed fuel temperature is attained, at which point the system reaches a state of electrical balance.

A fail-safe feature is also provided. In the event of power failure, a magnetic clutch in the actuator is released, permitting the air valve to be pushed open by the force of the ram air.

This application* on the P6M2 illustrates only one of many possible adaptations of the Airborne R-8010 system for temperature control functions on aircraft, missiles and related equipment—cabin temperature control, engine temperature control, temperature regulation of fuel, oil, electronic cooling packages, etc. If you have requirements in these areas, we will be happy to make a proposal. Contact any of our offices.

*Described in detail in new Bulletin PS-4A, available on request.

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AVIATION CALENDAR

(*Continued from page 5*)

gineers' Professional Group on Human Factors in Electronics.

Apr. 5-8—1960 National Aeronautic Meeting and Missiles and Aircraft Engineering Display, Society of Automotive Engineers, Commodore Hotel, New York.

Apr. 6-8—Structural Design of Space Vehicles Conference, Biltmore Hotel, Santa Barbara, Calif. Sponsor: American Rocket Society's Structures and Materials Committee.

Apr. 6-8—1960 National Meeting "Hyper-Environments—Space Frontier," Institute of Environmental Sciences, Biltmore Hotel, Los Angeles, Calif.

Apr. 11-13—Electrical Engineering in Space Technology, Hotel Baker, Dallas, Tex. Sponsor: American Institute of Electrical Engineers.

Apr. 12-13-14th Annual Spring Technical Conference, Institute of Radio Engineers in conjunction with the American Rocket Society, Hotel Alms, Cincinnati, Ohio.

Apr. 19-21—International Symposium on Active Networks and Feedback Systems, New York, N. Y. Sponsors: Polytechnic Institute of Brooklyn; Department of Defense Research Agencies; Institute of Radio Engineers.

Apr. 20-22 – National Symposium on Manned Space Stations, Institute of the Aeronautical Sciences, Ambassador Hotel, Los Angeles, Calif. Cosponsors: NASA; the Rand Corp.

Apr. 21—Annual Eastern Regional Meeting, Institute of Navigation, Key Bridge Marriott Motor Hotel, Washington, D. C.

Apr. 21-22—Southwest Metals & Minerals Conference "Metals and Materials for the Space Age," American Institute of Mining, Metallurgical and Petroleum Engineers, Ambassador Hotel, Los Angeles.

Apr. 27-28—National Meeting on Space Age Materials, Cincinnati Chapter of the American Society for Metals, Sheraton Gibson Hotel, Cincinnati, Ohio.

Apr. 28-29—Symposium on "Closed Circuit Respiratory Systems," Wright Air Development Division, Wright Patterson AFB, Ohio.

May 2-4—National Aeronautical Electronics Conference, Biltmore and Miami-Pick Hotels, Dayton, Ohio. Sponsor: Institute of Radio Engineers.

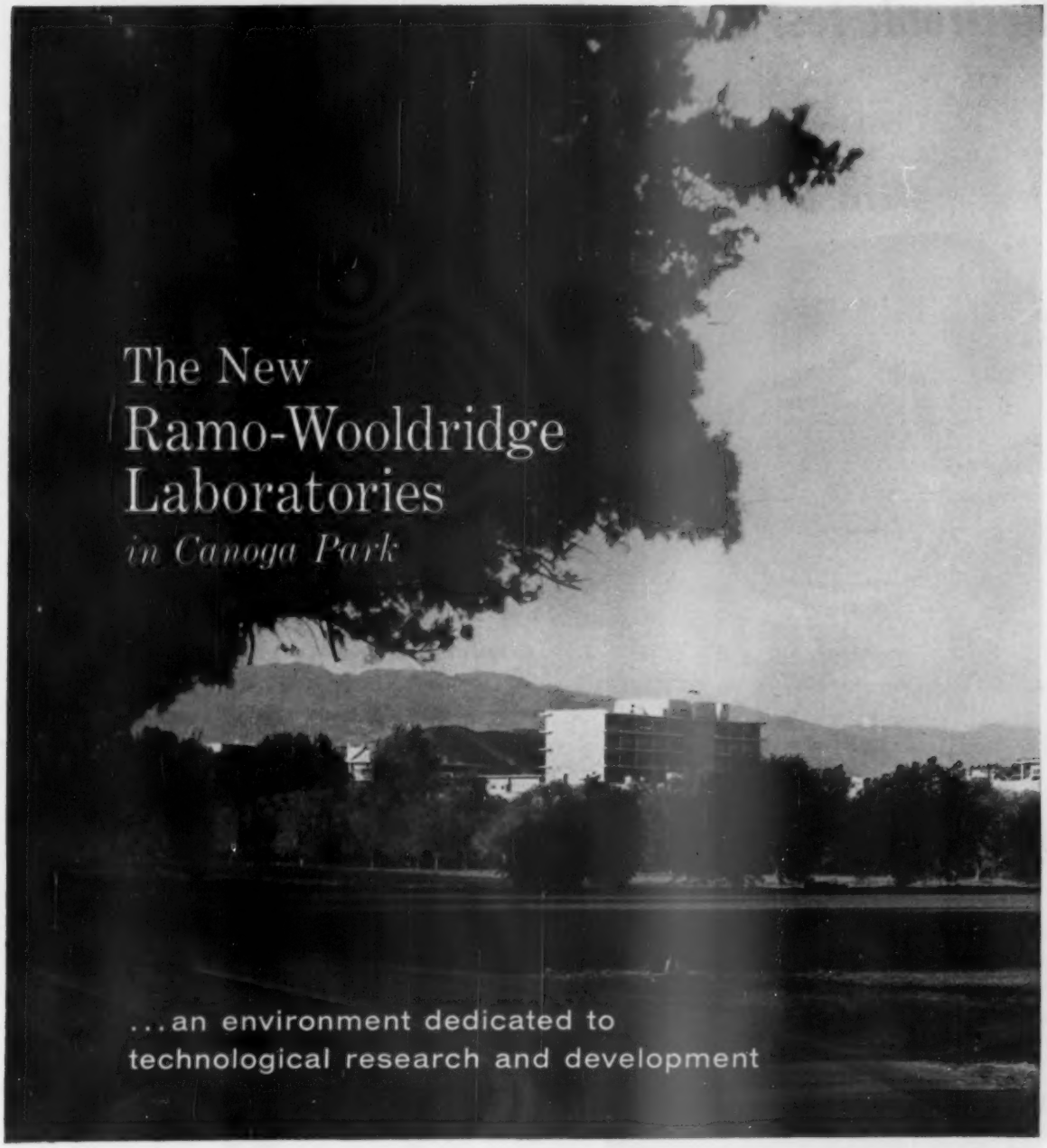
May 2-5—Sixth National Flight Test Symposium, Instrument Society of America, San Diego, Calif.

May 9-11—1960 Symposium of the Institute of Radio Engineers' Professional Group on Microwave Theory and Techniques, Hotel del Coronado, San Diego.

May 10-12—1960 Electronic Components Conference, Willard Hotel, Washington, D. C. Sponsors: Institute of Radio Engineers' Professional Group on Component Parts; American Institute of Electrical Engineers; Electronic Industries Assn.; Western Electronic Manufacturers Assn.

May 11-14—16th Annual National Forum, American Helicopter Society, Sheraton Park Hotel, Washington, D. C.

Aug. 15-20—11th Annual Congress, International Astronautical Federation, Royal Institute of Technology, Stockholm, Sweden.



The new Ramo-Wooldridge Laboratories in Canoga Park, California, will provide an excellent environment for scientists and engineers engaged in technological research and development. Because of the high degree of scientific and engineering effort involved in Ramo-Wooldridge programs, technically trained people are assigned a more dominant role in the management of the organization than is customary.

The ninety-acre landscaped site, with modern buildings grouped around a central mall, contributes to the academic environment necessary for creative work. The new Laboratories will be the West Coast headquarters of Thompson Ramo Wooldridge Inc. as well as house the Ramo-Wooldridge division of TRW.

The Ramo-Wooldridge Laboratories are engaged in the broad fields of electronic systems technology, computers, and data processing. Outstanding opportunities exist for scientists and engineers.

For specific information on current openings write to Mr. D. L. Pyke.

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Electronic test and maintenance costs

REDUCED 90%

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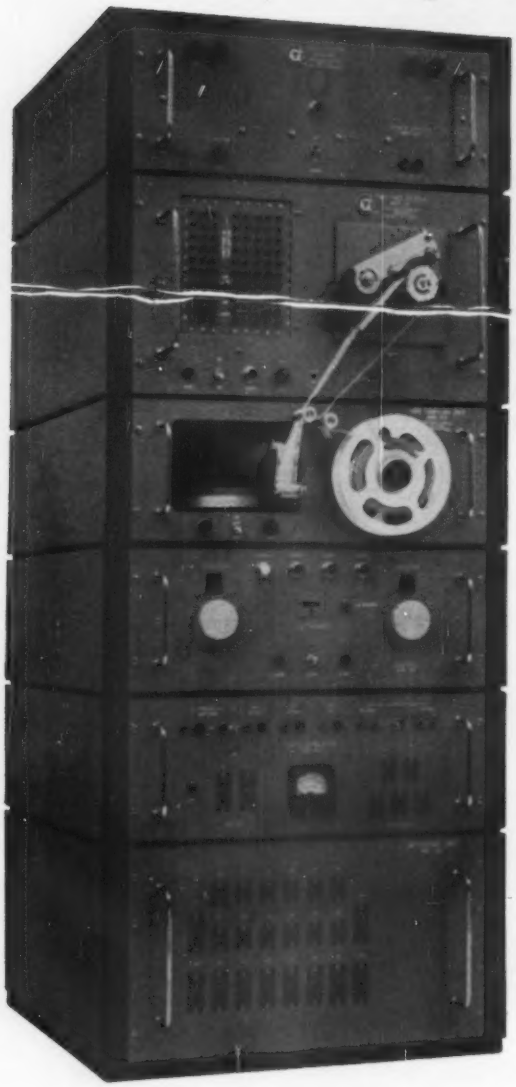

Drastically reduced test costs, increased equipment reliability and quality, incipient failures located during routine maintenance, decreased down time for vital equipment, production bottlenecks eliminated, no time wasted overhauling good units and needlessly replacing good components, exceedingly valuable in ground support—these are a few of the many reasons that CTI Supertesters are so widely used for all types of electronic and electrical testing from production to field maintenance. In making complete static and dynamic measurements on constituent circuits or in analyzing performance of entire systems, Supertesters have demonstrated time and again their advantages over other test methods.

Proved in over one year of use, the Model 180 Tape-Programmed Supertester is bringing a new versatility into automatic testing. With the accessory Tape Punch and Tape Duplicator, identical or revised copies of tapes can be made in seconds, an important feature where numerous design changes are of concern. Copies of tapes used by the original equipment manufacturer can be supplied for field use, always assuring that equipment is meeting the latest design specifications. In addition, lengthy test specifications are eliminated and the test instruments for a large variety of units are kept to a minimum —one CTI Supertester.

Write for complete specifications on the Model 180. A brief outline of your test requirements will enable us to advise you in more detail on the application of our testers to your needs. Related CTI products are the Model 165 Cable-Harness Analyzer, Model 176 card-programmed Component Tester, and Model 100 Supertester.

The new Model 180 Tape-Programmed Supertester has the same outstanding features that have made CTI automatic test equipment the leader in the field—high accuracy, go/no-go bridge measurements, widest scope of tests and auxiliary operations, and complete customer confidence in test results through fail-safe circuitry and self-testing ability.

Engineers: Career opportunities are currently available at CTI

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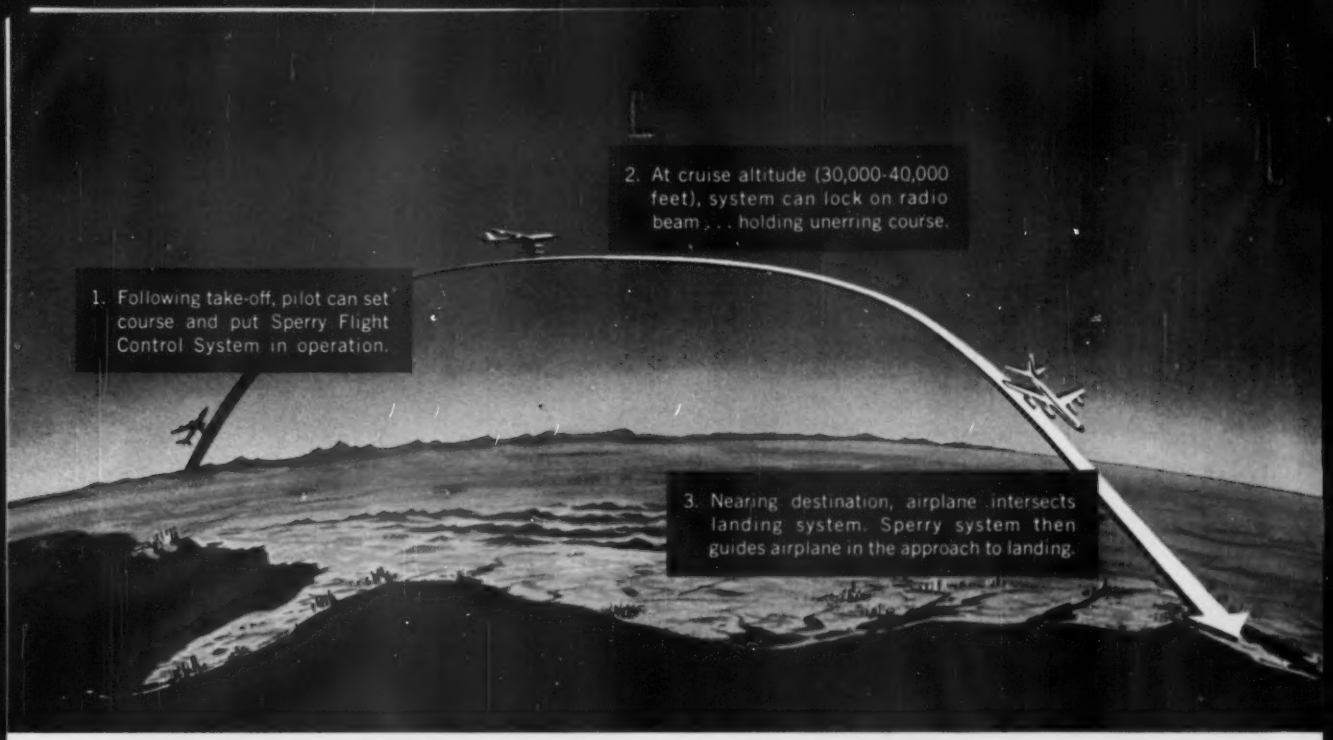
2. At cruise altitude (30,000-40,000 feet), system can lock on radio beam . . . holding unerring course.
1. Following take-off, pilot can set course and put Sperry Flight Control System in operation.
3. Nearing destination, airplane intersects landing system. Sperry system then guides airplane in the approach to landing.

LOCATED BETWEEN PILOTS, controls for Sperry system give pilot manual as well as automatic command of plane at all times. Panel instruments, integrated with automatic pilot, give pilot continuous visual data of his aircraft in flight.

UNITED AIR LINES DC-8 Jet Mainliner in flight. Seventeen other leading world airlines will soon offer schedules on the world's newest Jetliner . . . the Douglas DC-8.

Douglas DC-8 Jetliner Wins Acclaim

UNITED first of 18 airlines to fly new jets . . . called "major advance in air travel"

THE STORY BEHIND THE STORY

The new Douglas DC-8 Jetliner—carrying 140 passengers in luxury and comfort at speeds up to 600 miles per hour, and as far as 5000 miles non-stop—is news in itself. But behind that news is the story of another stride forward in air travel . . . another example of leaders in many phases of the aviation industry working together to make air travel more satisfying to the public, and more profitable to airline operators.

Sperry's contribution was development of the SP-30 Flight Control System—the first such system designed especially for multi-jet commercial aviation. Engineered to provide precision guidance of the 150-ton DC-8 in the stratosphere, at speeds up to 10 miles a minute, the SP-30 enables pilots to fly with unprecedented ease and accuracy.

In developing the SP-30, Sperry drew on nearly 50 years of experience in automatic flight and instrumentation. Since Sperry built the first automatic pilot in 1912, thousands of aircraft, both military and commercial, have depended upon Sperry for safe, comfortable and on-schedule flights.

For information, write Aeronautical Equipment Division, Sperry Gyroscope Company, Division of Sperry Rand Corporation, Great Neck, New York.

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URGENT PROBLEMS RELIABLY SOLVED

engine power
BY CATERPILLAR

Sawyer AFB, Truax AFB
CAT DIESEL ELECTRIC POWER
assures adequate lighting in case of emergency

At K. I. Sawyer Air Force Base, Marquette, Michigan, a Caterpillar D375 Electric Set supplies standby power for runway lighting. The set is equipped with automatic start-stop controls which enable it to pick up a full load in 4 to 8 seconds average.

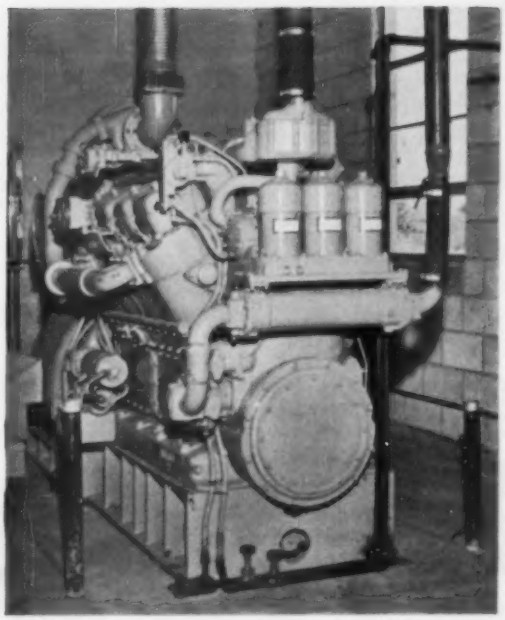
At Truax Air Force Base and Municipal Airport, Madison, Wisconsin, a Caterpillar D337 Series F Electric Set supplies emergency power for runway lighting and a CAA control tower. Landing beam lighting for controlled landings is also being installed on standby.

Caterpillar Electric Sets supply any quantity of dependable power from 30 to 375 KW. They are extremely efficient 4-cycle engines which operate on safe diesel fuels, ranging from JP-4 to No. 2 furnace oil. They start easily, pick up load quickly and can be operated and maintained by unskilled personnel. Parts and service are available throughout the Free World.

Special high-strength materials, strong reinforcing, simple compact design give Cat Electric Sets the stamina to operate for extended periods without letup. At Air Force Bases in the Atlantic, Cat Electric Sets have run over 20,000 hours without an overhaul, while supplying 68,000 kwh per month.

These are just a few reasons why Caterpillar Electric Sets are in service at so many military and civilian airports. Uses include primary and standby power for testing, starting engines, alert hangars, radar systems, lighting, heating, living and operating facilities.

Get the complete story on the advantages of Caterpillar Electric Sets. Write for our new booklet, "Guide Book on Emergency Power."



CATERPILLAR

Engine Division, Caterpillar Tractor Co., Peoria, Ill., U.S.A.

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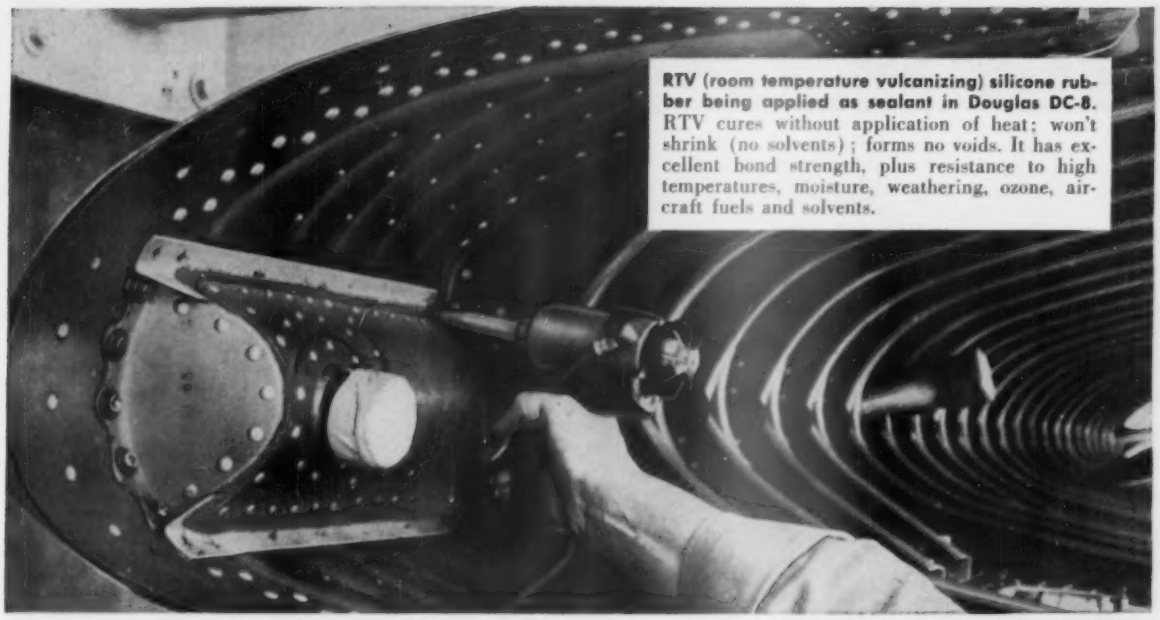
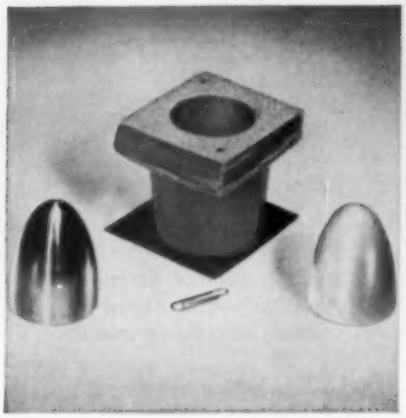
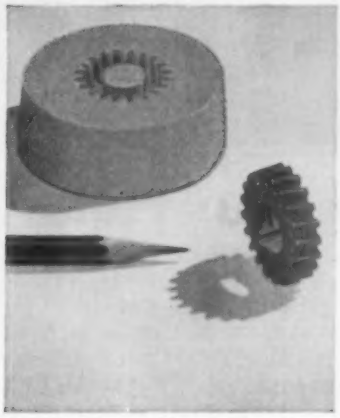


RTV (room temperature vulcanizing) silicone rubber being applied as sealant in Douglas DC-8. RTV cures without application of heat; won't shrink (no solvents); forms no voids. It has excellent bond strength, plus resistance to high temperatures, moisture, weathering, ozone, aircraft fuels and solvents.

G-E RTV silicone rubber—a superior material for tooling, encapsulating and sealing



Prototype jet engine nose cone (right) cast in RTV mold. Epoxy parts cast in flexible RTV molds have a bright, glossy surface and reproduce extremely fine detail. No parting agent is required for even the most complex parts. High tensile and tear strength is retained even after prolonged heat aging.



Close-tolerance, non-standard helix gear cast complete in low-cost, one-piece RTV mold. Previously such replacement parts had to be machined by hand. Now they can be quickly and inexpensively replaced by using the broken part as a master.

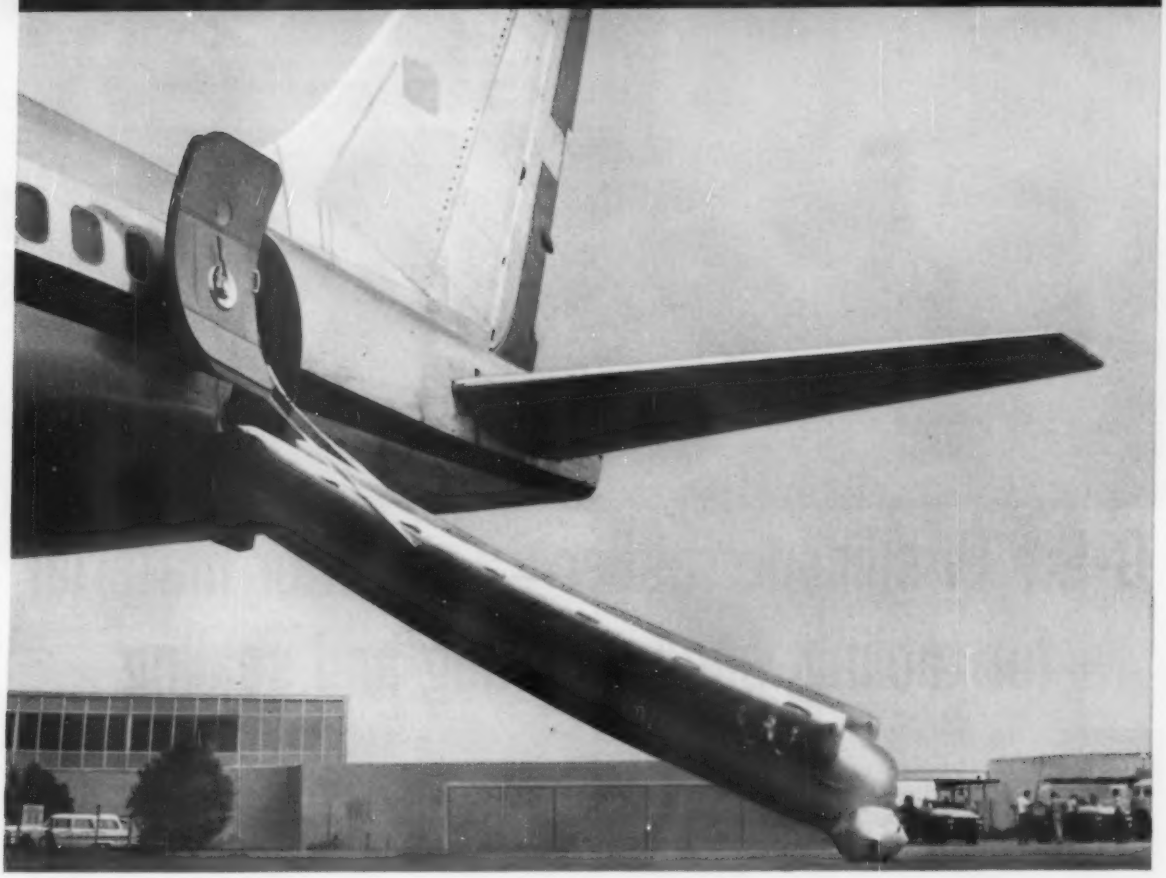
Potting and encapsulating of electrical components, such as this aircraft transformer, are easy with RTV. It can be poured, sprayed, painted or applied by dipping. Temperature resistant from −60°F to +600°F; excellent resistance to high altitude arc-over and corona. Comes in wide viscosity range.

For application data and samples of General Electric RTV silicone rubber, write to General Electric Company, Silicone Products Department, Section J22, Waterford, N. Y.

GENERAL ELECTRIC

Silicone Products Dept., Waterford, N. Y.

ESCAPE SLIDE / another product of Air Cruisers research



DEPENDABLE SURVIVAL EQUIPMENT

The Air Cruisers escape slide shown here assists passengers and crew to evacuate the aircraft in an emergency in a matter of seconds without injury. Simple to operate, it is standard equipment on most turbine-powered passenger aircraft.

Thoroughly tested by the military and commercial airlines, the inflatable escape slide is another major achievement in a field where Air Cruisers has been the leader for more than 30 years...dependable, lightweight survival equipment. The only manufacturer which conducts continuous research in survival equipment, Air Cruisers is America's most experienced fabricator of inflatables from rubberized nylon materials.

The Air Cruisers jet pump, which produces the rapid inflation vital to the fast, dependable operation of the escape slide, is another contribution toward better survival equipment. Today, more products, including life rafts, deceleration bags, etc., are inflated by Air Cruisers jet pumps than by any other kind.

Your inquiries are invited.

THE GARRETT CORPORATION

AIR CRUISERS DIVISION

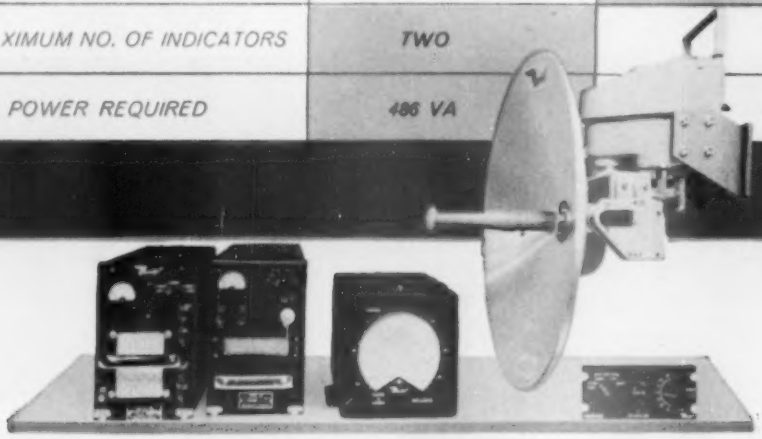
BELMAR, NEW JERSEY

LIFE JACKETS • LIFE RAFTS • HELICOPTER FLOATS • ESCAPE SLIDES • GAS BREATHER BAGS • DECELERATION BAGS

BENDIX RDR-1D AIRBORNE WEATHER RADAR WINS IN SIDE-BY-SIDE COMPARISON!

Only Bendix has this proved performance superiority

	BENDIX RDR-1D SYSTEM	OTHER X-BAND MAKE
RACK SPACE REQUIRED	**TWO 1/2 ATRs**	TWO 3/4 ATRs (SHORT)
RANGE	**UP TO 150 MILES**	UP TO 80 MILES
STABILIZED ANTENNA	**YES**	NO
SCAN ANGLE	**120°**	80°
ANTENNA TILT	**±15°**	±10°
WEIGHT	82 LBS	**50 TO 57 LBS.**
MAXIMUM NO. OF INDICATORS	**TWO**	ONE
AC POWER REQUIRED	**486 VA**	515 VA



Bendix RDR-1D System—TSO-C63

New FAA regulations have put airborne weather radar in the limelight . . . and emphasized once more the importance of using the most efficient system. Detailed comparison reveals that the Bendix RDR-1D System offers superior performance which means maximum flying safety for all types of aircraft.

The RDR-1D "sees" farther . . . up to 150 nautical miles. Its stabilized antenna prevents loss of picture while maneuvering . . . and the wider scan angle allows the pilot to see 50 per cent more target area.

Today over 1,500 Bendix Airborne Weather Radar Systems are now in daily service with airlines and business aircraft operators throughout the world.

For more details on the Bendix RDR-1D, the weather radar system *with experience*, write:

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VICKERS ECM COOLING SYSTEM plus

3M's FC-75 dissipates 47 kw input in 74 lb package

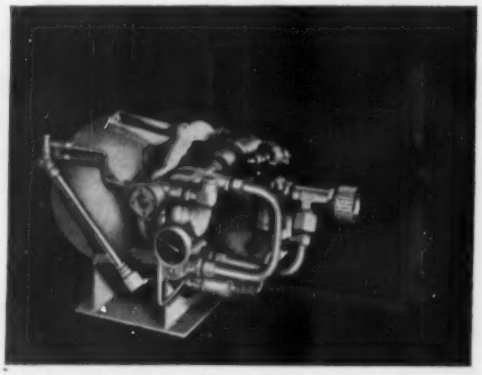
Vickers' 38 years of specializing in handling of fluids has been directed to "application-tailored" airborne cooling systems . . . reliable systems that are light weight and feature a broad range of flow and pressure characteristics.

This typical Vickers system circulates Minnesota Mining and Manufacturing Co.'s heat dissipating dielectric coolant, FC-75, through Sperry's advanced design electronic countermeasures system.

Heart of the Vickers cooling system is a single-stage, centrifugal pump that generates relatively low pressure and moves fluids at high flow rates. Because it is inherently simple in design, the Vickers pump offers high reliability and simplifies maintenance. Bearing design permits operation with fluids having low viscosities, in this instance FC-75, a fluordinated hydrocarbon.

Included in this package are safety interlocking devices for the protection of the pumping unit and ECM system. Maximum operating efficiency is assured even under unusually severe operating requirements. Such assurance stems from Vickers proven skills developed by long experience in designing and building components and systems for handling all types of fluid.

Write for Bulletin A-5244 for more details.



PUMPING UNIT AND CORE. Large airborne cooling system developed by Vickers' Aero Hydraulic Products division makes efficient use of 3M's FC-75 dielectric coolant to dissipate heat from electronic countermeasures equipment. Output pressure is required to be approximately 100 psi with fluid flow rates as high as 52 gpm. Operating range is from —65°F to 210°F. Pumping unit weighs 54 lb. dry and the heat exchanger core only an additional 20 lb. Shown below is part of the extensive testing program conducted by Vickers to prove out the new design. It included extremes of heat and cold as well as vibration, shock, attitude and other physical tests.

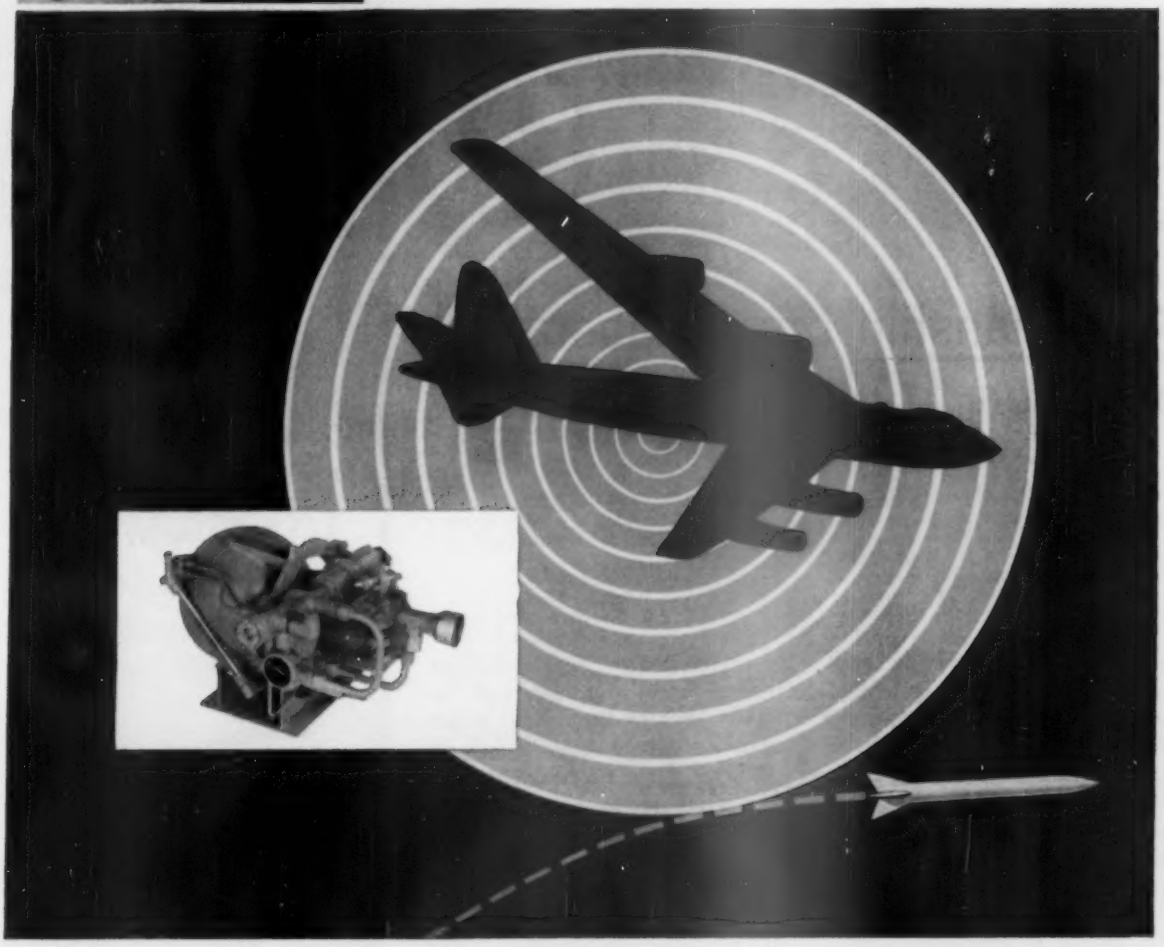
8485

AERO HYDRAULICS DIVISION
VICKERS INCORPORATED
DETROIT 32, MICHIGAN

division of
SPERRY RAND CORPORATION

3M COMPANY CHEMICALS

THE RAW MATERIALS OF PROGRESS



HOW TO HOLD A JAM SESSION 8 MILES UP

Vickers active cooling system (inset) uses FC-75 in countermeasures system

The increasing sophistication of electronic countermeasures systems poses many problems. Among them—how to cool vital components at the environmental and operational extremes encountered in sonic and supersonic aircraft.

For the Sperry countermeasures system, a new airborne active cooling system—capable of dissipating 47KW in a 74-lb. package—was developed by Vickers using 3M Dielectric Coolant FC-75.

This most stable of all fluids offered to electronics has high electric strength of 37KV. It is self-healing, and maintains electric strength after repeated high voltage arcing. It pours at −148°F and boils at 212°F at one atmosphere . . . ideally suited for evaporative cooling.

Compatible with most materials, FC-75 is non-corrosive, non-flammable, non-toxic, non-explosive and odorless. It is thermally stable in excess of 800°F, and will not form sludges or gums under extremely rigorous conditions. These properties make it ideal as a coolant.

Investigate the remarkable properties of 3M inert fluids in terms of your own product design, miniaturization and performance problems. For free literature, write to 3M Chemical Division, Dept. KAW-20, St. Paul 6, Minn.

CHEMICAL DIVISION

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. . . WHERE RESEARCH IS THE KEY TO TOMORROW

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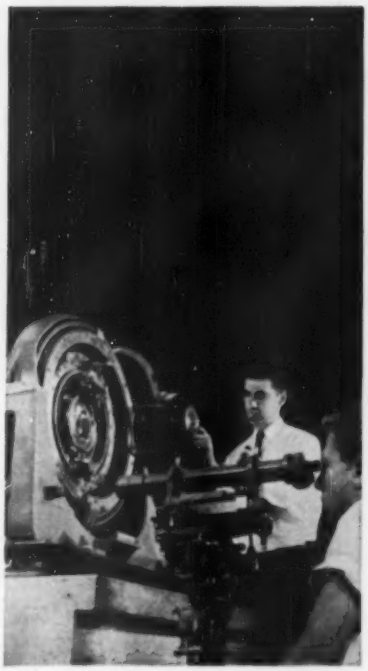
Knowmanship brings laboratory precision to mass production



Craftsmanship to extra-fine tolerances is not uncommon on limited volume production. But this same precision on a mass-volume basis is rare. In fact, mass-produced precision is one of the big advantages accruing to prime contractors who select Eclipse-Pioneer KNOWMANSHIP for their teams.

Case in point is our production and testing of air-bearing gyros for the latest generation of missiles. Parts for these inertial guidance systems are *mass-produced to accuracies as fine as 10-millionths of an inch* and are assembled by us in "the world's cleanest room"—99.95% free of dust specks larger than 5-millionths of an inch in diameter. Then, to check out these ultra-precise mechanisms, we built a battery of E-P modified sidereal drive test stands having an accuracy of .005° per hour.

This is but one example of how E-P KNOWMANSHIP becomes *a professional partner* for prime contractors—bringing important "extras" that help "primes" get contracts and then fulfill those contracts in less time and at lower cost. For complete information on how KNOWMANSHIP is already being efficiently applied in the system areas listed below, call, wire or write us today.

69% of E-P's procurement dollars go to small business.

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▶ Objective is agency that would encourage travel through fare cuts and aid growth of independents.

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COVER: Development testing of modified turbojets powered by a nuclear reactor is being conducted at the Atomic Energy Commission's National Reactor Testing Station near Idaho Falls, Idaho. Heat Transfer Reactor Experiment No. 3, designed and built by the Aircraft Nuclear Propulsion Department of General Electric for USAF and AEC, is designed on a large scale to facilitate servicing and accommodate instrumentation. It consists of an air-cooled direct cycle reactor on a railway car. Jet exhaust nozzles are in foreground.

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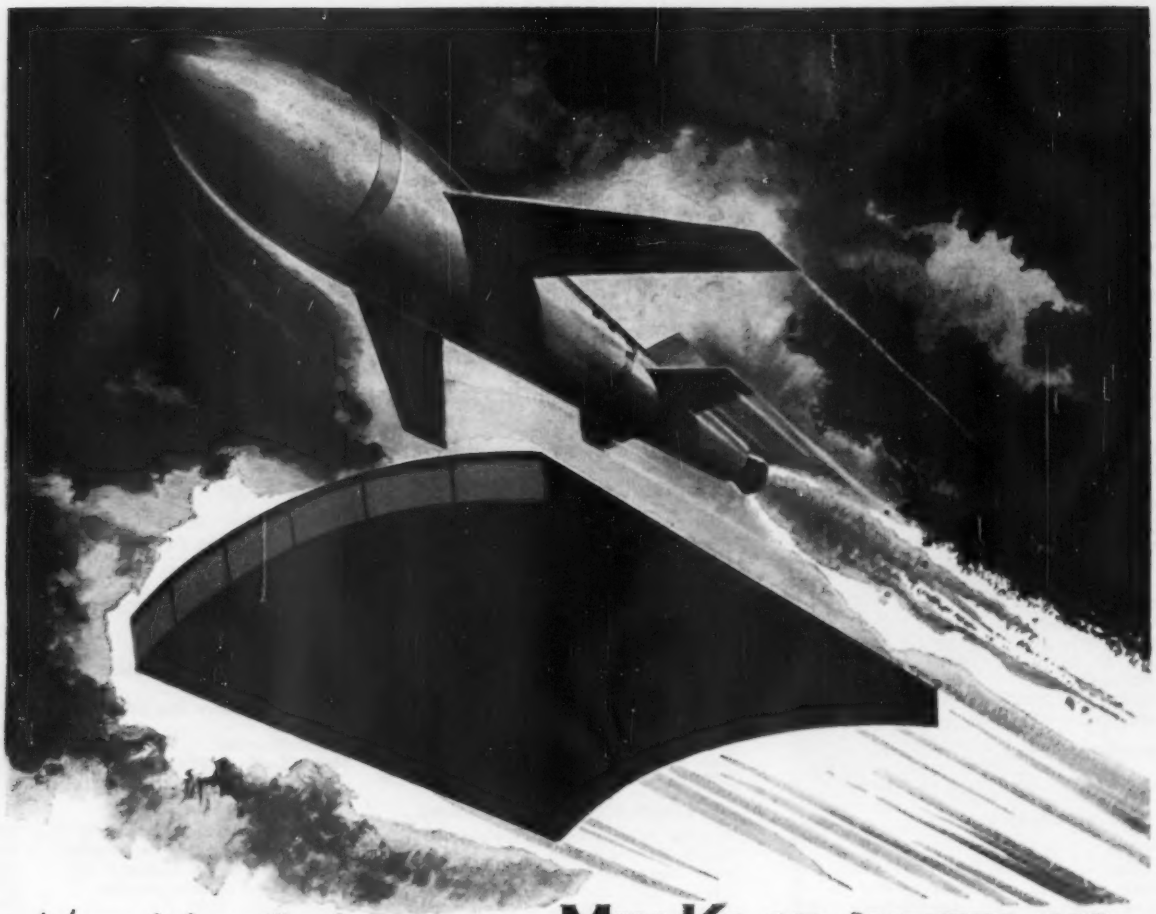


Johns-Manville Announces... MIN-KLAD INTERLOK

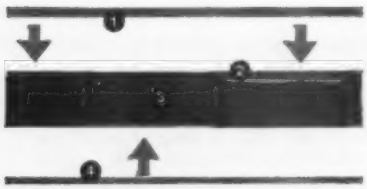
. . . a new structural system interlocking Min-K insulation and high-temperature reinforced plastic

Missile experience shows that in certain heat control situations no one material will perform as well as two (or more)—*an insulation with protective high-temperature facings.*

Problem is how to effectively combine these materials into a structurally strong unit? The answer is Min-Klad Interlok—a new structural system that interlocks Min-K insulation and reinforced plastic, metal or other high-temperature facings.

The result: one product that gives the missile designer every advantage of high-temperature plastic or metal foil—strength, toughness, rigidity! Erosion resistance! High heat capacity!

. . . plus the outstanding advantages of Min-K insulation—an insulating core that has the lowest thermal conductivity available for service temperatures up to 2000°F steady-state, and higher for transients. Min-K's thermal conductivity is actually lower than the molecular conductivity of still air.



1) Outer facing, 2) Interlocking web, 3) Core, any one of several Min-K formulations, and 4) Inner facing.

All the above components combine to provide a custom-made structural strong insulating system.

Wide range of facings

For the hot face, the missile designer can specify Min-Klad Interlok in a wide variety of heat-resistant and/or ablating materials—asbestos-phenolic (ARP-40), and similar reinforced plastics, as well as stainless steel and other heat-resistant metal foils and meshes. For some requirements, the cool face can be made of a different material—for example, one that offers characteristics required for bonding or fastening to other surfaces and parts.

Like all J-M Aviation insulations, Min-Klad Interlok is factory-fabricated to your specifications into external skin panels, heat shields, cylindrical liners or component housings of any shape or size. Write today for technical specifications. Address Johns-Manville, Box 14, New York 16, New York. In Canada, Port Credit, Ontario.

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EDITORIAL

Military Space Bid

(Maj. Gen. O. J. Ritland, commander of the Air Force Ballistic Missile Division, recently defined what he termed the "strategic importance of space" and urged that, in the interest of national security, vital military space programs be pushed through their development cycles on a top-priority basis. Because of the current debate over whether the military actually has a role in space and—if so—to what extent, AVIATION WEEK is reprinting below significant extracts of Gen. Ritland's speech before a Los Angeles meeting of the Institute of Radio Engineers.)

. . . We can no more ignore space from the security point of view than we can ignore the seas around us or the atmosphere just above us. . . .

We are not venturing into space simply because it is there, but because space is the new medium where strategic operations may well be conducted with great effect. It does not take a student of military history to recognize that the nation which has the courage and the foresight to tap the advantages of new theaters of operation, and to forge ahead into those new frontiers, will inevitably become the leader. Until the Soviet nuclear breakthrough of 1949, the United States possessed a monopoly both on the nuclear weapon, and on the means to deliver it. This, in effect, was absolute deterrence. From 1949 through the early fifties we no longer held a monopoly in the nuclear field, but we still retained the edge in airpower. Now, however, we hold no monopoly—either in nuclear knowledge or in the means to deliver nuclear weapons. . . .

As technology has progressed, time and distance have been compressed. The world, however, is not growing smaller. Rather, man is growing larger in his ability to command the forces of nature.

We are involved today in a conflict of ideologies with the Soviet Union. The so-called cold war is being waged along many fronts—political, social, economic, psychological, educational, and technological. If the Soviets achieve a substantial edge in missile and space weapon systems, the blackmail capability associated with such a margin of power could be used against the free world, perhaps as decisively as the weapons themselves. Conversely, the better equipped we are in modern hardware capabilities, the stronger will be our position at the diplomatic peace tables.

. . . Since it is imperative that we offset (Soviet) initiative by early warning, and intelligence advantages by surveillance, we in the Air Force have taken concrete measures to develop space systems which will contribute substantially to our defensive capabilities. Two specific programs are the satellite projects we call Midas and Samos.

Midas (Missile Defense Alarm System) is the Air Force answer to the requirement for early warning. It is the defender which will cut sharply into the Soviet advantage of initiative. An ICBM travels a quarter of the distance around the world in about 30 minutes. Because of its tremendous speed it outruns even the transmission of information given us by our present warning systems. At this time we have no active defense against it. . . .

Simultaneously with our development of Midas, we are proceeding with the Samos program. Samos is the Air Force nickname for the global surveillance satellite system which will counteract the Soviet advantage of intelligence information. It is the time-proven military advantage of "high ground" carried to the near ultimate.

When a nation is confronted with the risk of war, it is important that those who must make decisions have the benefit of current and valid information about the other nations involved. If this information is not available, the possibility of mistakes and miscalculations is increased.

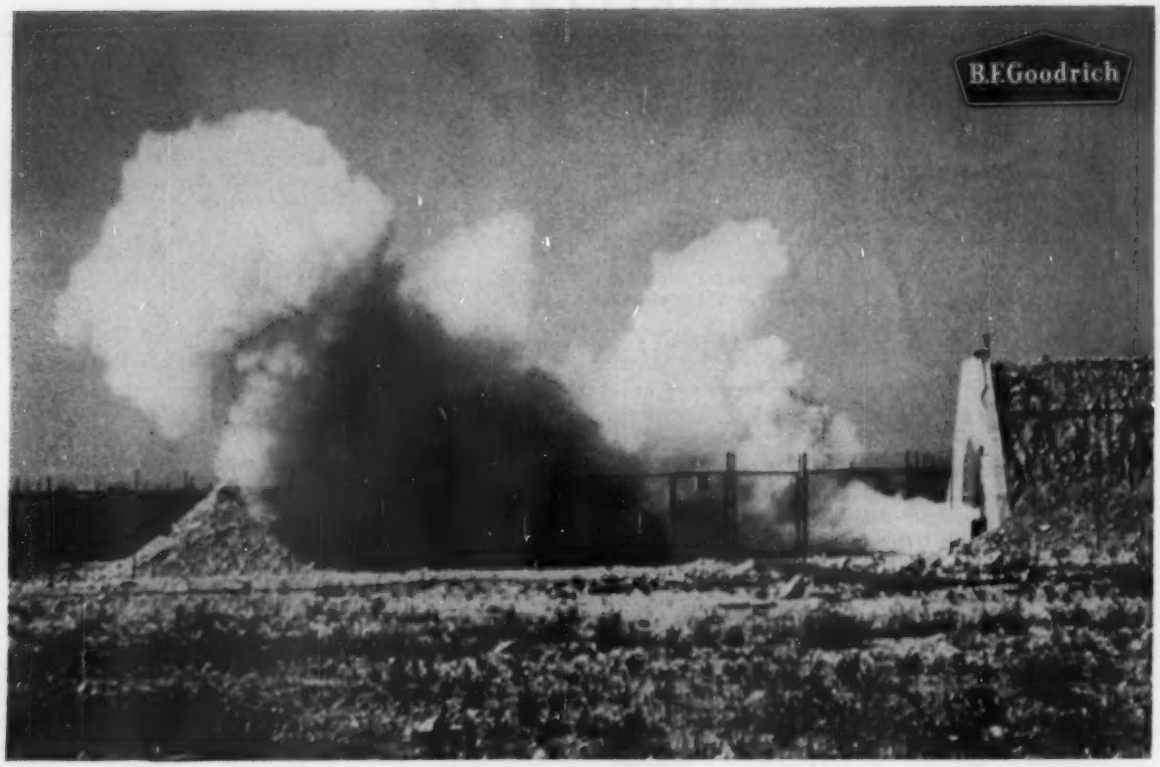
By proceeding concurrently with all aspects in the development of ballistic missiles; i.e., the construction of bases and the training of personnel while the weapon is still undergoing research and test, we have demonstrated that calculated risk can pay big dividends in the forging of a major weapon system within a tightly-compressed time schedule. This same concept of concurrency, and the priorities and funds that go with it, should now be applied to the expeditious development of our military space systems. . . .

We must meet the broad challenges of space. For through the intelligent exploration and exploitation of space, man can extend his horizons, contribute to his comfort and welfare, and augment his knowledge. He can do none of these things, however, and I emphasize this fact, unless he commands the freedom and the security to exercise his full talents. In this critical age we must exploit all promising ventures into space. It is vital that we equip ourselves with the knowledge that must be evoked from the unknowns of space. Our two great objectives—to increase human knowledge and to defend human freedom—are important to each other. In fact, the civilian and military space programs are not contrary, but mutually productive.

. . . In the years just ahead, with warning and reaction times measured in minutes, effective communications will be a decisive element in future military operations. . . .

While dependable, the delayed repeater communication system between a satellite and ground stations imposes some degree of delay in transmission. To overcome this the Advanced Research Projects Agency of the DOD is investigating the unique characteristics of 24-hour equatorial satellite systems. Three such satellites, each put into orbit 19,400 miles above the earth, would provide line-of-sight visibility to all points except those in the polar regions. Calculations show that a relatively low power radiated from the satellite to the ground station is sufficient for many megacycles of band width. Consequently, high-capacity intercontinental communications will be possible. . . .

We are well beyond the Buck Rogers era of science fiction. Space is with us—and we must get with it if we are to reap the advantages there for those who demonstrate the foresight and have the daring to seek them. The stakes in this space race are astronomical; the rewards can be enriching beyond imagination. The penalty for tardiness, indecision, or complacency can be equally vast. . . .



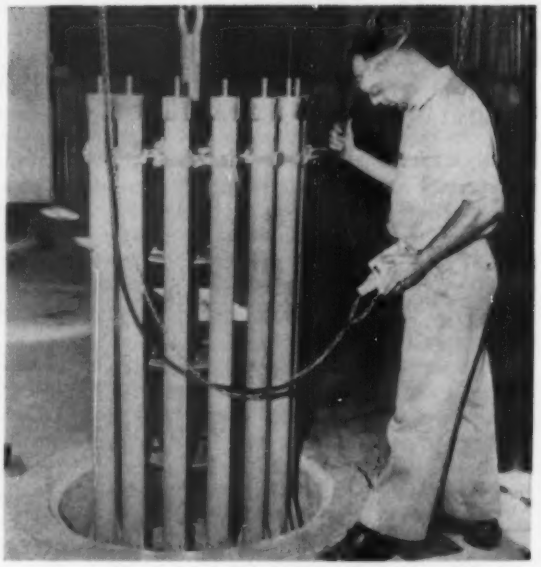
B. F. Goodrich producing high-energy solid propellants

This static test tunnel is one of the 56 specialized facilities at the B. F. Goodrich solid propellant plant, Rialto, California. BFG-made propellants are currently being processed and loaded in solid fueled rocket motors of the LOKI, RTV and ASP types.

B. F. Goodrich pioneered the development of the major polymeric binder-fuels now being used in our country's most advanced missiles... Liquid "C" synthetic rubber and polyurethane. BFG solid fuels are outstanding in their high energy performance, and have excellent castability, ideal physical properties at low and high temperatures, excellent burning characteristics and batch-to-batch uniformity.

B. F. Goodrich is qualified and equipped to handle complete rocket motor projects... from complete design through testing and shipment. BFG also produces rocket motor cases, case and nozzle liners and other parts in conjunction with complete propulsion systems. Test and production motors containing cast and case-bonded propellant grains in various sizes and weighing up to 2,000 pounds have been successfully manufactured and fired.

For complete information on how BFG solid propellant facilities can help you, write for a copy of the new booklet "B. F. Goodrich Solid Propellants for the Space Age". *B. F. Goodrich Aviation Products, a division of The B. F. Goodrich Company, Department AW-2D, Akron, Ohio.*



Lowering a rack of small rocket motors into curing pit at the BFG Rialto plant after propellant has been poured into the cases. B. F. Goodrich has been engaged in composite solid propellant research since 1952—in motor production since 1957.

B.F.Goodrich aviation products

WHO'S WHERE

In the Front Office

Clyde Skeen, new executive vice president and general manager of Temco Aircraft Corp., Dallas, Tex., also elected a director.

Charles N. Oursler, a vice president, American Airlines, Inc.

Gen. O. P. Weyland (USAF, ret.) has been named a consultant to Aerojet-General Corp., Azusa, Calif., and a member of the corporate advisory board.

E. Sohier Welch, Jr., vice president-engineering, Fenwal, Inc., Ashland, Mass.

George A. Peck, president, Southwestern Industrial Electronics Co., Houston, Tex.

Johan H. G. Maters, executive vice president-manufacturing, Perkin Engineering Corp., El Segundo, Calif.

Henry C. Guhl, vice president-engineering, National Vulcanized Fibre Co., Wilmington, Del.

John M. Thompson, vice president and general manager, Itemlab, Inc., Port Washington, N. Y.

Ernest A. Wester, vice president and treasurer, Servomechanisms, Inc., Hawthorne, Calif.

Dr. Victor B. Corey, vice president, United Control Corp., Seattle, Wash.

William D. Stone, vice president and general manager, Acor, Inc., El Monte, Calif.

Dr. T. Paul Torda, director of propulsion and fluids research, Armour Research Foundation of Illinois Institute of Technology, Chicago, Ill.

Honors and Elections

Lt. Gen. Donald L. Putt (USAF, ret.), president of United Technology Corp., has been appointed a United States national delegate to the NATO Advisory Group for Aeronautical Research and Development.

Juan T. Trippe, president of Pan American World Airways, has received the 1960 Transportation Award of the National Defense Transportation Assn. The citation, which noted PAA's contribution to national defense, read in part, ". . . within half an hour after the Japanese attack of Dec. 7, 1941, the peacetime activity of PAA ceased and the more than 20,000 employes joined our national defense."

T. F. Dixon, director of research and engineering for Rocketdyne Division of North American Aviation, has been named chairman of an ad hoc group charged with recommending to the Department of Defense a program of research and development of advanced rocket propulsion systems.

Chicago Helicopter Airways has received the Lawrence D. Bell Helicopter Pioneer Award in recognition of the airline's contribution to the helicopter industry during the past decade.

Richard B. Canright, chief of the Douglas Research Section-Missiles and Space Systems Engineering, has been named recipient of the 1960 Astronautics Engineer Achievement Award by the National Rocket Club "for his contribution to the initiation of the Saturn and Centaur space booster vehicles and the 1.5 million-pound-thrust-rocket engine projects."

(Continued on page 105)

INDUSTRY OBSERVER

► Air Force hopes to improve the quality of aerodynamic test data needed for the design of the Dyna-Soar boost-glide vehicle through a series of large-scale model flights using National Aeronautics and Space Administration's Chance Vought Scout rocket as a booster. Large-scale free flight data up to orbital Mach numbers would remove much of the uncertainty now surrounding the Dyna-Soar design, in the opinion of many Air Force advisors, and could strengthen the project's status at the budget table. Approval of the necessary financing and ability to obtain the needed Scout vehicles will be primary facts in determining whether the tests will be carried out.

► Project Transit navigation satellite payload is being reduced by Navy from 270 lb. to 50 lb. so that the relatively inexpensive Scout solid rocket can be used as a launcher instead of the originally-planned liquid-solid fueled Thor-Able vehicle.

► Advanced Research Projects Agency is expected to hold an open industry-wide competition for Project Spad, armed anti-ICBM satellite program (AW Jan. 4, p. 18).

► Federal Aviation Agency soon will call for industry bids for the development of a minimum-cost air traffic control transponder for use by small aircraft. FAA's Bureau of Research and Development will hold a briefing session for potential bidders in Washington on Mar. 11.

► Air Force is studying proposals for an all-supersonic, longer range version of the North American Hound Dog diversionary missile for the Boeing B-52 by substituting a Pratt & Whitney JT12 turbojet powerplant for the Pratt & Whitney J52 now used. Although the JT12 has only 2,900 lb. thrust as compared with 7,500 lb. for the J52, decreases in weight, frontal area and fuel consumption would provide additional speed and range.

► Monitoring procedures for the high altitude nuclear bursts conducted under Project Argus in 1958 included use of small satellites air-launched from Navy aircraft.

► Mobile missile range system incorporating four KC-135 jet tankers as the carriers is being proposed by Boeing. Specially modified with elaborate tracking and data processing equipment, the aircraft could be placed in a world-wide airborne pattern to monitor launches of U. S. space and military vehicles. Antennas would be carried in a long pod located on top of the KC-135 fuselage. Boeing also points out that the aircraft could be strategically placed to monitor Soviet space and missile firings.

► Stretchouts in the Boeing KC-135 tanker program have reduced current production to seven or eight aircraft a month—approximately half that of a former high production rate of 15 aircraft per month.

► Crewmen for Strategic Air Command ballistic missile squadrons will be obtained primarily through reorganization of the command's Boeing B-47 wings. Several B-47 wings will be deactivated, and the aircraft and air crews of each will be divided and assigned to two of the remaining B-47 operational wings. Ground personnel from the deactivated wings will be sent to ICBM schools and eventually assigned to operational missile squadrons.

► Soviet navy is believed to be installing defensive guided missile systems aboard its destroyers to protect its surface forces.

► Target missile for Army's Nike Zeus anti-missile missile in test firings in the Pacific will be the Army-Chrysler Jupiter topped by the Lockheed Agena-B upper stage. The Agena stage, powered by a Bell Aircraft engine equipped with re-ignition capability to permit restarting, will be fired on the way down, after it has reached the highest point of its trajectory. Nike Zeus system depends on spotting the re-entering body at the high point of its trajectory in order to make its intercept. Jupiter-Agena will be fired first from Johnston Island in the Pacific.

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A portable field instrument that finds true north automatically is now available to America's new mobile Army. It is called ABLE and has been TYPE CLASSIFIED by the U. S. Army, TO & E No. LIN279415. ABLE swiftly determines true north . . . day or night, in all weather, and anywhere in the world up to latitudes of 70 degrees.

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Inertial instruments by Autonetics

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INERTIAL NAVIGATION / ARMAMENT AND FLIGHT CONTROL / COMPUTERS AND DATA SYSTEMS

Washington Roundup

Apparently increased concern in Republican Party circles over the defense issue convinced President Eisenhower he should take some positive action to combat Democratic attacks. First he went to Cape Canaveral, then he decided to discuss the issue on a national broadcast. And he decided to squeeze the broadcast in before leaving for South America, indicating a concern over the recently increased potency of the issue.

Eisenhower apparently intends to pit his military reputation against all criticism and depend on his prestige to carry him through the fight. He continues to accuse his critics of narrow partisanship and political motivations. And he continues to stress his own military background and the objectivity of his top military advisers.

A strong fight from Eisenhower can rally support to the Administration position but probably not enough to offset Democratic control of the purse-strings. If the Democrats cling to their determination to make defense an election issue, they have more than enough power to vote extra money for controversial projects like the North American B-70 Mach 3 bomber.

Mutual Security

Mutual security program appears headed for the usual deep congressional cuts this year. Estimates of cuts run as high as $1 billion from the $4.175 billion budget the President urged on Congress last week. Program includes about $2 billion for military aid, and this is included in the U. S. defense budget for the first time. Eisenhower says $2 billion is needed this year to refill the depleted military aid pipeline.

Military assistance element of the defense budget is ripe for cuts to make way for increased U. S. defense spending. Democrats are generating pressure for a bigger military effort and military aid is an easy place to cut to compensate for heavier domestic spending. This would keep the total budget from too great a jump and help the Democrats temper any "fiscal irresponsibility" label.

Presidential advisers seem to be edging away from his stand that the U. S. is not in a race with Russia. Science adviser Dr. George B. Kistiakowsky has spoken of the scientific and technological contest with the Soviet Union "which today involves our national prestige, and tomorrow, perhaps, our very survival." Earlier this month, Secretary of State Christian A. Herter conceded some international prestige to Soviet space successes. He admitted Soviet achievements have been more glamorous than U. S. efforts.

Herter warned last week against allowing scientific advances to drive the world to general war through miscalculation. He urged a more stable military environment to control the dangers of a continuing arms race and spiraling competition in strategic delivery systems.

Electronics Boomerang?

Some electronic firms are afraid the Electronic Industries Assn. fight against Japanese imports (see p. 30) may boomerang. Seeking to restrict imports of Japanese semiconductors, EIA has questioned government-supported research and says profits from commercial sales should finance research on military products. Some EIA members are afraid the Defense Department might ask industry to apply this philosophy to development of defense electronic equipment.

There is little prospect for action this year on proposals for a single space agency. Sen. Stuart Symington (D.-Mo.) joined the roster of single agency sponsors last week, asking for an integrated military-civilian effort under one top level official. President Eisenhower is strongly opposed to such a move, and no real congressional support for it has developed.

State Department is expected to hold firm against heavy Dutch pressure for an airline route to Los Angeles. Netherlands has told Secretary of State Herter of its disappointment, and the Dutch parliament has passed a resolution asking the U. S. to reverse its decision and permit KLM Royal Dutch Airlines to fly to Los Angeles. State is expected to stand by its refusal.

Wrapup

House Judiciary Subcommittee launched hearings last week on proposed bills to strengthen the federal conflict of interest laws . . . Commerce Department has completed its study of national transportation policy, and it is ready to go to the White House for approval. Commerce also is asking for a permanent staff to conduct a continuing review of transport policy . . . Senate Commerce Committee will hold hearings this week on the nomination of Alan Boyd to the Civil Areonautics Board.

—Washington Staff

U.S., Soviets Race to Develop Air-Launched

Boeing B-52H will carry GAM-87A Sky Bolt; Soviet plans to use Bear turboprop, Bounder platforms.

Washington—United States and the Soviet Union are in a new technical weapons race to produce an operational air-launched ballistic missile. The U.S. program is based on the GAM-87A Sky Bolt ALBM which is projected to boost the strategic strength of manned bombers by adding a new generation air-to-ground offensive punch.

The U.S. has decided to produce the Sky Bolt for use on the Boeing B-52G and B-52H jet bombers which are now carrying Hound Dog missiles (AW Feb. 8, p. 33).

The Soviet development program is already under way. Plans probably are to use the ALBM on the Bear turboprop (several hundred are now in service), on the Bounder supersonic delta now in flight test stages, and, in particular, on its nuclear-powered versions.

Decision to put the WS-138A program (parent program for the Sky Bolt) into its development phase is based on design-objective compromises in areas affecting range, accuracy, and timetable. Department of Defense decision, weighed by Director of Defense Research and Engineering Herbert York, hung on two critical capability aspects:

• **Could the GAM-87A be developed** to operational status within a reasonable period before the time when existing manned bombers may be considered to become obsolete? This broad requirement may have been tied into a tentative projection for initiating phase-out of the North American GAM-77 Hound Dog air-breathing air-to-surface missile in 1963 and phasing in the GAM-87A at that time, with complete transition to the latter by 1965. The possible timetable stretchout for GAM-87A may have stemmed from the probability of introducing an improved-performance version of Hound Dog, which is being proposed by North American.

• **Could accuracy and reliability** be developed, within the timetable limit, to give an "almost-on-target" hit capability required for a strategic weapon of this type? By the time GAM-87A would become operational, weapon analysts feel that its circular error probability (CEP) may be delineated in hundreds of feet.

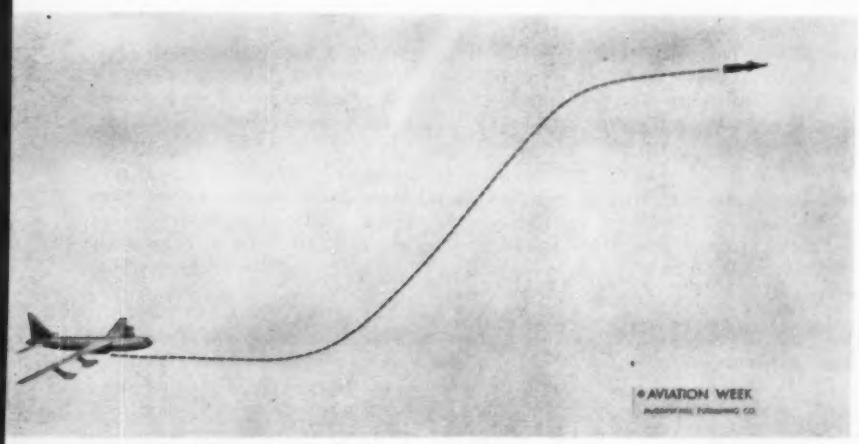
Nuclear Warhead

The two-stage solid-propellant GAM-87A missile to be developed by Douglas Aircraft is the largest yet planned for air launch with a nuclear warhead. It is seen by industry weapon-analysts as following this general pattern:

• **Launch into a 200- to 300-mi.-high** out-of-atmosphere ballistic subsonic (600 mph.) speed from a launch altitude between 35,000 and 45,000 ft.

• **Attain a speed** of about 5,000 mph. after launch, probably re-entering at a substantially higher speed, for relative immunity to anti-missile measures as it follows its trajectory for target impact.

• **Span a range** of 1,000 to 1,500 mi., affording a high degree of security for the launching bomber by allowing it to release its weapon far from the target.



PROFILE view shows artist's version of an ALBM heading for out-of-atmosphere trajectory shortly after launch from B-52.

Utilization of the GAM-87A is seen by industry analysts as working out this way:

• **Boeing B-52 Model G** (for development and operational missiles) and B-52H (for operational missiles) will be the only USAF bombers tagged to mount the GAM-87A, according to present projections based on the anticipated status of Strategic Air Command bomber inventory. The B-52 would carry one missile under each wing. Launch of a single missile may introduce a severe problem of asymmetrical loading, since the missile may weigh as much as 10,000 lb. This may require launch of both missiles simultaneously.

• **Britain's V-Bombers**—Handley-Page Victor and Avro Vulcan Mk.2 probably will be modified to carry the GAM-87A—perhaps in a belly position because of weight considerations. This application may use a scaled-down version of the missile. British Air Ministry and Royal Aircraft Establishment representatives were in this country last summer discussing details of possible deployment of GAM-87A on the V-bombers.

• **If a nuclear-powered bomber** is developed to operational status, it also would be armed with the GAM-87A. Availability of the missile, at very least three to five years before a U.S. nuclear-powered plane might become operational, brings into sharp focus the earlier availability of this type of missile and plane combination in Russia.

• **GAM-87A is not planned** for use on USAF's Convair B-58. Fitting it to this bomber would have introduced difficult compromises involving adequacy of clear space between inboard nacelle and wing root.

• **North American B-70 Mach 3** intercontinental bomber also will not be programed for arming with the missile. Under the original timetable for the B-70, first probable delivery of an operational plane would not be before late in 1964, with first wing delivery not before late 1965. Strategic Air Command has been anxious to earmark the GAM-87A for the B-70, probably anticipating at least a five-year utilization on this plane, followed, perhaps, by transition to nuclear-powered bomber.

Initial Study

While waiting for the Defense Department signal to begin the development phase of WS-138A, which may involve funding of approximately $125 million, weapon system prime contractor Douglas Aircraft Co. had completed its initial study effort. This basic study had been funded with an additional $3 million to carry it to the middle of February. Early in the study, Aerojet-General

BallisticMissile

was awarded the subcontract for the solid-propellant rocket motors. General Electric was given the job to develop the re-entry vehicle.

Last fall, Northrop Corp.'s Nortronics Division was awarded the missile guidance subcontract. Competition for a universal test set–ground checkout equipment for the missile–was also scheduled. This was narrowed to three finalists, then suddenly held in abeyance, with indications that Air Force itself would procure this equipment instead of delegating development and procurement to a contractor.

Transition Period

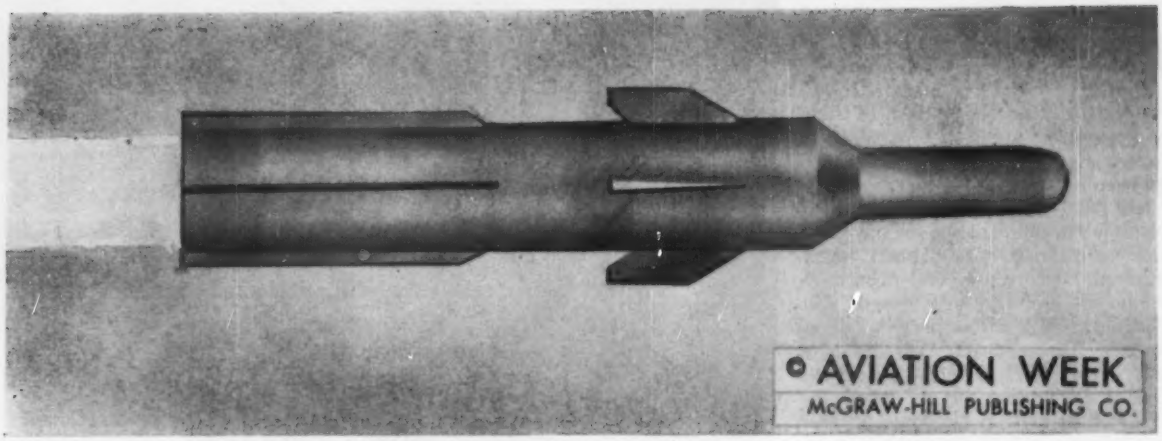
During the transition period which usually follows the end of a feasibility study and leads into the research and development phase, Douglas gave a detailed presentation of status and projections to a full government and industry complement concerned with the weapon system–including Department of Defense, Air Research and Development Command, USAF Headquarters, Strategic Air Command, Wright Air Development Division project personnel, and industry members including Nortronics Division, Aerojet-General, and Boeing Airplane Co., and others. Apparently, this was Douglas' final input before the Department of Defense decision to support the follow-on development phase.

A broad band of weapon system analysts representing many industry companies have studied the general parameters of air-launched ballistic missiles. These studies grew out of the intra-industry competition before Douglas was awarded the WS-138A contract.

Indications are that general characteristics and mission requirements for the weapon system would have to fall into these broad limits:

- **Solid propellant rocket motors** to give adequate performance for a weapon of this type would be about 25 ft. long over-all and about 3 ft. in diameter. Allocating this to two stages probably would give a booster stage of about 18 ft. long, plus a second stage about 7 ft. long behind the nose section. A single stage missile also would be applicable, but would introduce considerable sacrifice in range.
- **Booster stage** would have long, shallow fixed fins to coincide with long booster configuration. Second stage probably would carry canard surfaces. One scheme might have canard surfaces actuated for in-atmosphere control, with jets in the nose fed by a solid-propellant gas generator for out-of-atmosphere control. Reverse thrust orifices in the leading edges of the canard

ARTIST'S conception of an air-launched ballistic missile shows flight pattern as the weapon is fired from a B-52 in horizontal attitude, then starts climbing steeply into a ballistic trajectory. After booster stage burnout and separation, the second stage would push the warhead to peak altitude before the weapon begins re-entry for fast impact on target.



MISSILE would have high fineness ratio, probably would mount shallow fins on booster, stubby fins on second stage.

surfaces could operate to assist separation of second stage from payload.

• **An alternate plan,** instead of using jets for out-of-atmosphere control, might embody thrust vectoring through use of jetavators in the exhaust stream, or through use of swiveled nozzles, since each stage likely will use smaller multiple nozzles instead of a single large nozzle. Thrust chamber gimbaling is unlikely due to complexities involved.

• **Operational technique** likely will be for the missile to be cut loose from the launch airplane at about 40,000 ft. altitude, a reasonably high altitude to provide a safe margin of drop but only a short free fall would be programed before the first stage would ignite at a safe distance below the aircraft. A guidance signal from the launching aircraft would shift the missile from its powered flight horizontal attitude into its ballistic trajectory. Burning time would be relatively short—probably less than a minute—for fast acceleration to peak altitude, perhaps 200 to 300 mi. higher than the launch point.

• **Precise pre-launch computer** inputs probably would "memorize" trajectory and target refinements. It's reasonable to assume that the missile will be fitted with a built-in capability of selecting a substantial number of alternate targets, according to a complex system of programing. Missile analysts feel that as many as 20 alternate choices would not be unreasonable for a missile of this type if top effective strategic capability is to be achieved.

• **Targeting capability** will take on prime emphasis, might be aimed at achieving accuracies on the order of hundreds of feet, anticipating enemy capabilities at the time the GAM-87A would become operational. Closely tied in with this capability will be the ability to predict rocket motor thrust levels within a relatively low percentage of tolerance, both in the booster and in the second stage.

• **Future operational refinement,** not likely to be projected for first-generation operational missiles, might be the inclusion of a television capability in the nose, which could transmit a picture back to the launching aircraft far in the rear, to identify the target on which the warhead would impact.

• **Various compromises** undoubtedly will be involved. One of these areas would be consideration of warhead weights versus choice of ranges. Estimates are, for a vehicle of this type, taking into consideration propellant specific impulses likely to be available when the missile is approaching operational status, that each extra pound of missile weight will slash nearly one mile from range capability.

• **Ablative-type lightweight** nose cone probably will be favored—another detail to extend range. High-temperature plastic materials for this type of service have been scrutinized carefully by re-entry specialists.

• **Relatively shallow re-entry** angle—perhaps not exceeding 40 deg.—likely would result from a trajectory pattern which would be calculated to combine a reasonable out-of-atmosphere altitude with adequate horizontal "reach." This shallow re-entry would cut down the heat erosion effects if a plastic nose cone material were used.

Soviet Pacific Tests for ICBMs?

Washington—Soviet Premier Nikita Khrushchev referred to the vehicles recently tested by Russia in the Pacific Ocean as "powerful intercontinental ballistic rockets," in a speech before the Indian Parliament. For the first several weeks after Moscow announced that the test firings would be made, all Soviet references spoke of "rockets" or "cosmic rockets," and the words "intercontinental" and "missile" were not used. Recently, however, both words have been used by Communist commentators (AW Feb. 15, p. 31).

Initial study effort at Douglas has not been limited to theoretical analysis. Usual procedure is to investigate some of the more difficult design features in a few versions of the missile in tunnel runs with speed ranges exceeding the speed projected for the operational missile. Jets for out-of-atmosphere control is one item which might be evaluated in feasibility studies.

Tempo of development will have to be reasonably fast if all components of the weapon system—missile, aircraft and missile computers, checkout equipment—are to be brought along concurrently to meet initial operational capability, which may take three years.

Considering the number of operational aircraft on which the weapon would be deployed, along with spares requirements for stocking in dispersed global locations, quantities for testing during the development phase, and routine air-crew training exercises to maintain operational efficiency, a total somewhere between 1,000 and 2,000 of the missiles probably would be required. This would require a gradual buildup to a fairly high production rate—considerably in excess of that attained with any surface-to-surface ballistic missile system.

Automatic test equipment to service the missile's complex circuitry and sequencing may be one of the factors contributing to the original development timetable delay because decision has not yet been reached for test set procurement. Estimates are that at least 25 of the test sets would be required to meet the demands of the development, production, and operational phases for the missile. Programing equipment probably would have to be transportable by air for availability at any aircraft base.

Test set would stress heavily the reliability of components and it is likely that vacuum tube use would be held to a minimum. Capability to keep abreast of missile refinements also would have to be built into the unit.

Contractors to Share Development Costs

By Philip J. Klass

Washington – Defense contractors beginning July 1 will have to dig into profits to underwrite part of the cost of company-initiated development programs which formerly were treated as fully allowable items of expense for cost and incentive type contracts, according to new principles enunciated in a recent revision to Armed Services Procurement Regulation.

Air Force already has called in more than a dozen major contractors to tell them that they must now share the cost of company-initiated developments. Air Force reportedly is asking companies to share about 50% of the cost of development but is negotiating each agreement on an individual basis.

USAF has encountered considerable objection from industry to the new policy because contractors see it as another blow to profit margins which many believe already are too low (AW Jan. 18, p. 101).

The new Air Force policy, and the joint services policy which goes into effect July 1, do not apply to development programs specifically contracted for by the services. However, this might be the next step.

Company-initiated research – which the revised ASPR defines as the search for more knowledge or better understanding as differentiated from development which normally involves hardware –will receive more liberal treatment than in the past, however.

Formerly, company-initiated research was not an allowable item of indirect cost unless provision for it had been made in the company's defense contracts. After July 1, such items will be allowable, providing the company prorates its research costs to all company products, including consumer and industrial as well as defense.

'Reasonable' Research

Company-initiated research and development must both pass the test of "reasonableness" before they can be considered as allowable cost items under the new ASPR revision. In evaluating whether such programs meet this criteria, government negotiators will consider size, cost and scope of, previous company research and/or development.

Another, and more controversial, criteria for allowability that will be applied solely to company-initiated development programs is that they must be "related to the product lines for which the government has contracts (with the company)."

The revised ASPR also rules out the capitalization of "unrelated" development cost for and subsequent charge-off against future government production that might result.

The purpose of this provision is to prevent the use of taxpayers' money to put a company into new types of business. But, in the fast-changing defense business, this provision probably will raise a number of thorny problems of interpretation.

For example, if a company is currently producing jet engines under government contract but decides to establish a company program to develop rocket or ion propulsion engines, is this effort "related to the product lines for which the government has contracts?"

Because the development effort is in the propulsion field, and for application to air/space vehicles, the contractor can be expected to argue that it is related. But under a strict interpretation of the revised ASPR, such development might be disallowed as a new field of endeavor and one that the company should finance out of profits.

Reviewing Committee

To resolve questions of this sort, and to review proposed company-initiated research and development programs of major defense contractors, a Tri-Departmental Committee for Administration of Research and Development is being established in the Defense Department. It will include both contracting specialists and government scientists. The latter will analyze company programs and recommend whether they should be treated as research or development and related to production for ASPR purposes.

If a legalistic approach is used to interpret the related-to-current-production ASPR provision, some observers fear it might lead to "bootleg development," in which contractor-initiated development is disguised to appear to be related to current government production when, in fact, it is aimed at a new type of product.

Even if company-initiated research and/or development programs get over the hurdles of reasonableness and relation to existing production, contractors can expect to be asked to share the costs of such effort. The new ASPR Section 15 suggests that "cost sharing (between government and contractor) . . . may provide motivation for more efficient accomplishment of such program."

The section also says, "it is desirable in some cases that the government bear less than an allocable share of the total cost of this program." This can be done in several ways:

- **Government accepts full costs** of certain specific projects as allowable items of expense but completely disallows costs on certain other projects.
- **Government accepts a percentage** of contractor's planned research and development program as allowable, with the company bearing the balance.
- **Government and contractor** agree on a maximum dollar value that will be treated as allowable item of expense.

Air Force Views

Explaining the reasons behind USAF's recent action, which anticipated the new ASPR revision, an Air Materiel Command spokesman told Aviation Week that the amount of company-initiated research and development which companies seek to write off against production contracts has grown by leaps and bounds in the last several years. This, coupled with decreased amounts of production, has caused indirect costs to mushroom.

As a result, AMC finds that a sizable portion of its funds intended for production of hardware is going to underwrite company-initiated research and development, which actually is not the function of the command.

Company-initiated development has long been a source of friction between some of the services and some contractors. From the service point of view, these development programs, in effect, are financed entirely with defense funds, yet the service has had no control over the direction of the company effort. Furthermore, the government normally does not obtain the patent rights as it does under direct government-sponsored programs.

Industry's position, and particularly among companies which have industrial and commercial business, is that it is, and long has been, standard practice to conduct company-sponsored development and allocate the cost of such effort to current production as an indirect charge.

Some industry representatives see the new policy as part of a continuing effort to drive down profit margins on defense business. Indications are that none of the services plans to permit higher profit margins on defense business to cover increased contractor expense from the development sharing policy. As one Defense Department official expressed it to Aviation Week: "Industry will have to finance such efforts out of existing profits as the price for staying ahead in defense technology to assure future business, or else curtail its development programs."

Defense Department is now trying to work out the ground rules for applying the new ASPR principles to assure uniform interpretation by the three serv-

ices. Within the next four to six weeks, the Defense Department hopes to issue form instructions and have its Tri-Department Committee established.

Approximately 35 defense contractors known to have extensive company-initiated research and development programs already have been invited to submit reports which describe their specific programs for evaluation by a group of government scientists which will serve on the Tri-Department Committee.

Present plans call for the establishment of a single government/contractor cost sharing ratio for each contractor to be used by all three services. The ratio will vary between contractors.

The Air Force reportedly has reached agreement on cost sharing ratios with at least four major contractors—General Electric, International Business Machines Corp., North American Aviation and Western Electric. The cost sharing ratios were not revealed.

Union Opposes Industry Position On Japanese Electronics Imports

Washington—Electronic Industries Assn. has warned that the government must either restrict the import of Japanese semiconductors or else "initiate a full-scale program of direct government assistance" to the U.S. semiconductor industry if it is to avoid the risk of a "second-rate electronics industry."

EIA's warning is contained in its answer to the recent Japanese reply to the association's earlier petition asking the Office of Civil and Defense Mobilization (OCDM) to take action to restrict semiconductor imports from Japan (AW Dec. 28, p. 24).

Opposition to EIA's stand and support for the Japanese position came from an unexpected source—the International Union of Electrical, Radio and Machine Workers (IUE), which recently filed a statement of union views with OCDM.

The IUE says that, as a representative of employes in the electronics industry, it is "as eager as others to see that American industry and American workers are not hurt by unfair competition from abroad." But it urges the OCDM to make an economic study to determine whether the higher prices of U.S. semiconductors result from higher unit labor costs or from excessive profits.

Citing EIA's own figures that U.S. industry's transistor sales for first 11 months of 1959 were up 67% over the previous year, while dollar sales were up by 107%, the IUE said "it is very difficult to see that an industry which is growing so fast is in danger of being crippled by Japanese imports."

Figures released last week by EIA showed that during the 12 months of 1959, U.S. producers turned out 75% more transistors than in 1958, with dollar sales almost double those of 1958. Electronic Industries Assn. points to government estimates that by 1964 approximately 200 million transistors will be required for defense needs. This, EIA points out, is two and one-half times the country's 1959 production and almost one and one-half times its estimated output for 1960. (AVIATION WEEK analysis of figures released earlier by EIA shows that U.S. transistor production has increased six and one-half times in the last three years and has gone up by a factor of almost 3:1 in the past two years.)

The association says that, "unless the government exercises some control over Japanese imports of semiconductor products, the electronic industry cannot be expected to sustain continued capital investments in plants and facilities to meet national defense needs; nor should it be expected to finance research programs that are vital to the growth of the industry and which contribute greatly to military technology and its advancement."

(The same week in which EIA filed its answer to the Japanese, Philco announced it was cutting prices of its silicon and germanium transistors up to 52%. The company also said it is constructing a new $3.5 million manufacturing facility for producing silicon transistors.)

EIA denies the Japanese position that entertainment-type transistors, which Japanese export, are a separate market from the higher quality transistors used for military applications. The association says both military and non-military transistors involve similar manufacturing processes and "generally come off the same production line." Ground-based computers used to control guided missiles and for missile detection "employ many of the same germanium transistors and diodes used in entertainment equipment," EIA claims.

In answer to the Japanese statement that its transistor exports represent only 3.5% of the U.S. semiconductor industry's output in dollar value, EIA says that U.S. manufacturers "can hardly exist solely on the military market. Unless they can foresee profitable commercial markets, they would have little, if any, justification for remaining in business. The general growth of the (U.S.) semiconductor industry is directly attributable to the evolution of new products and the possibility of large markets and not because of possible speculative military needs," EIA says.

(During the same week EIA submitted its reply to OCDM, Transitron Electronics Corp., producer of diodes and transistors primarily for military and industrial use, reported December quarter sales were up almost 16% from the previous quarter, with earnings up 12%. On December quarter sales of $11.8 million, the company showed a net profit after taxes of $2 million.)

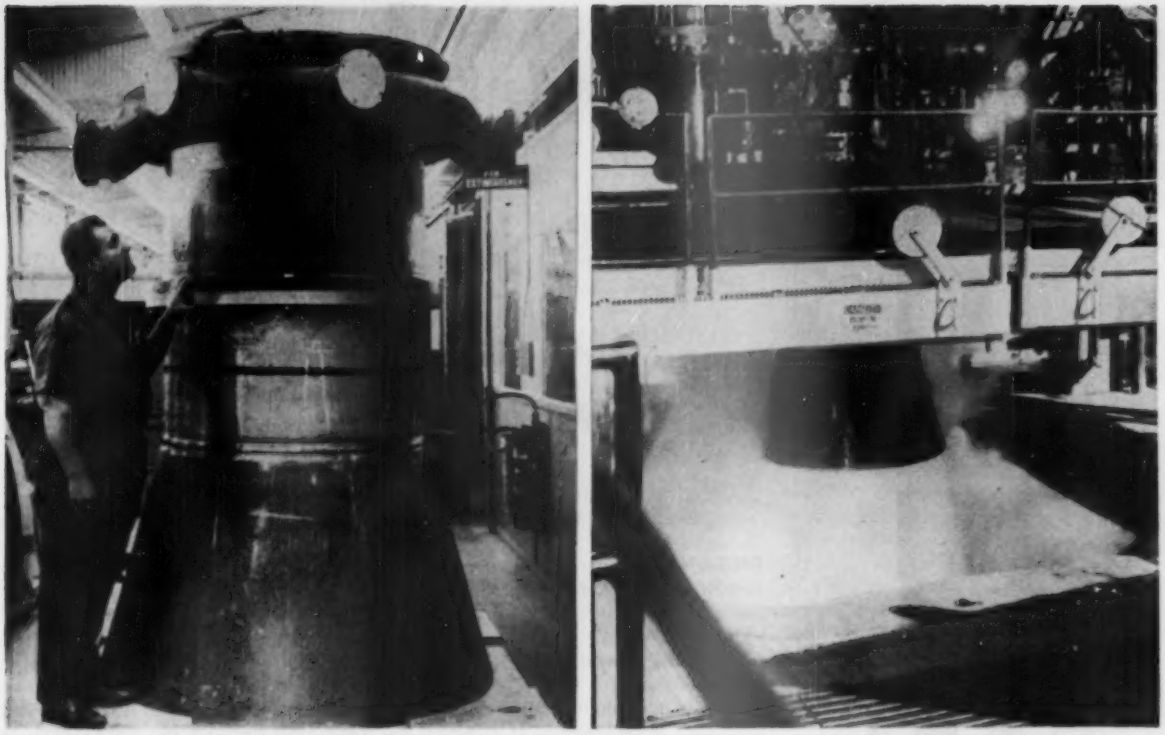
The Japanese had cited several major U.S. semiconductor manufacturers who voluntarily chose not to make transistors for the entertainment market. The Japanese also cited a decision by Raytheon made prior to the inroads of Japanese imports to abandon the consumer market and concentrate on military/industrial type semiconductor devices.

EIA concedes that government semiconductor procurement programs contribute to technological improvements in military electronics, including semiconductors. However, EIA says that, if an OCDM study shows "a dependency of this industry upon government subsidized research, a serious question will be presented as to whether it is appropriate to use such means indefinitely to maintain life and vitality of the entire industry."

The IUE, in its statement filed with OCDM, says it believes "maintenance of reasonable opportunity for Japan to export to us is necessary to our national security. An unwise action against Japan would be construed by other nations as the beginning of similar actions against them, since there is no reason why a similar policy would not be applied to almost any imports on which a national security connotation can be developed.

"There is no doubt," IUE says, "but that the security of our country would be endangered were we to lose our friends and allies by unwise actions in the trade field."

The union cites a number of U.S. electronic firms, many of them domestic semiconductor producers, who have bought into Japanese firms and/or are negotiating technical cooperation or export arrangements with them. IUE says that "if, as the (EIA) petition claims, Japanese imports are threatening the national security of the U.S. and, if American companies are aiding these Japanese imports, can it be therefore deduced that by their activities (these) American companies are helping to undermine the national security? We are not willing to make such a charge, but does it not naturally flow from the nature of the very petition that has been filed?"



UNCOOLED test device (left) for Rocketdyne 1.5 million-lb.-thrust engine has been run at over 1 million-lb.-thrust. Test chamber was producing that power (right) when photograph was made. F-1 is being developed for National Aeronautics and Space Administration.

Space Technology

NASA Studies Lunar Landing Projects

By Ford Eastman

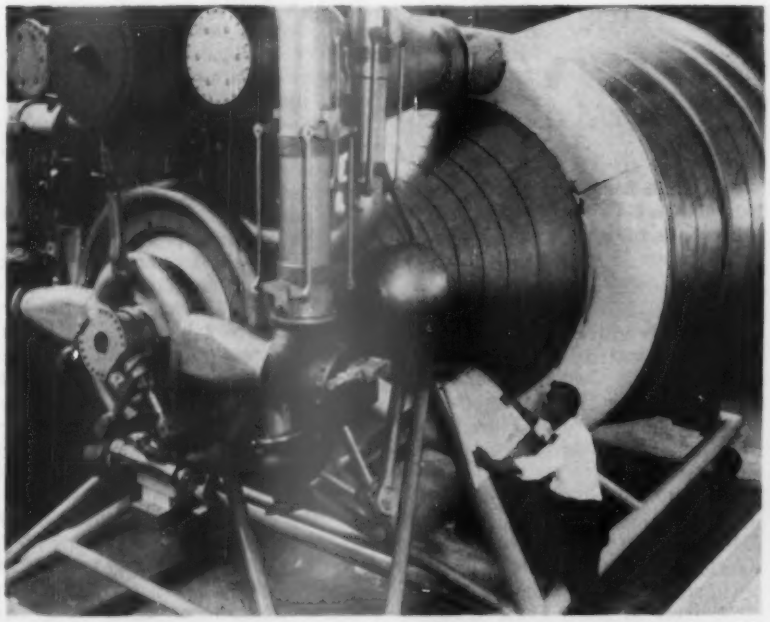
Washington—Soft lunar-landing systems for the Atlas-Centaur and Saturn boosters and gas cushion techniques to absorb the impact of instrumented hard landings are under study by National Aeronautics and Space Administration.

Richard V. Rhode, NASA's assistant director of research for structures, materials and aircraft operating problems, told the House Committee on Science and Astronautics last week that the gas cushion, because of its "attractive simplicity," is undergoing "extensive theoretical and experimental investigation in our research centers."

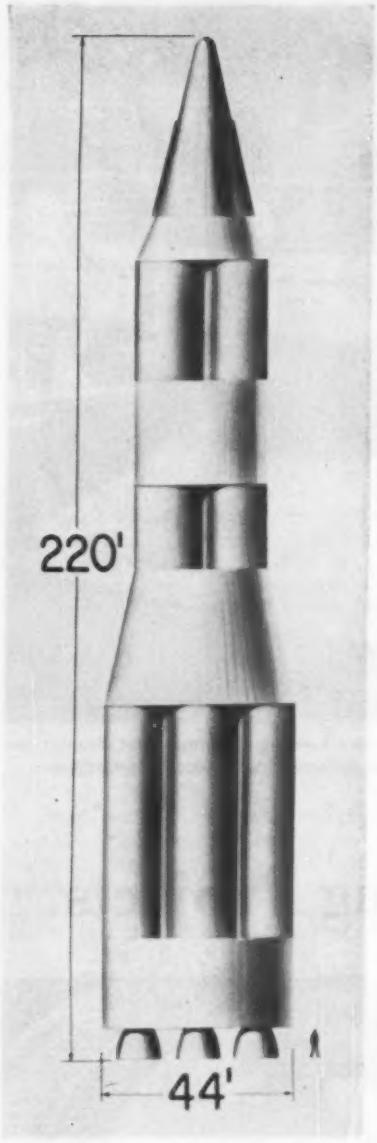
Three Methods

Three methods for safely landing instruments on the lunar surface were described by Rhode—crushable structures, penetration spikes and gas cushions.

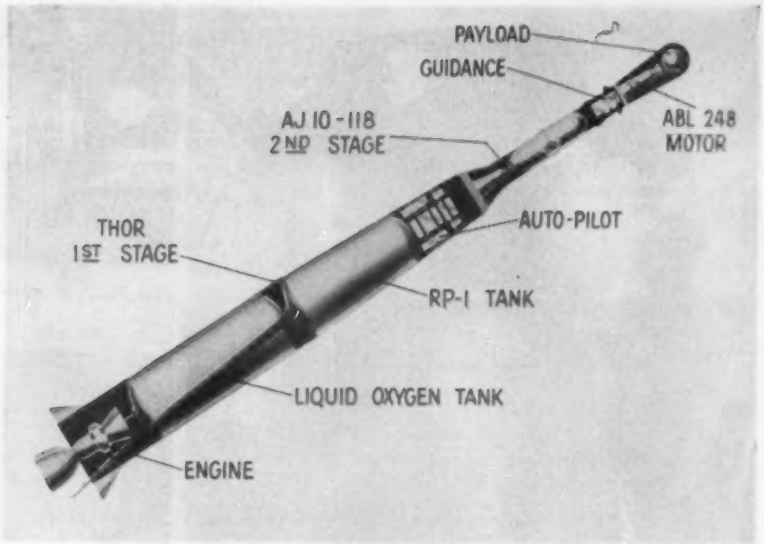
Under the latter—and most attractive—concept, the instrument package is suspended from the cushion by a number of radial cords. Upon impact, the cushion compresses until the instrumentation comes to rest on the lunar surface, absorbing the energy by compression of the gas, shock waves gener-



EARLY FULL-SCALE mockup of the Rocketdyne F-1 Rocket engine (AW Feb. 8, p. 26) shows general configuration. When clustered, the engines would produce up to 9 million-lb.-thrust, sufficient to place about 150,000 lb. of payload in a space orbit.



NOVA vehicle would use F-1 engine, put 290,000 lb. in low orbit, 60,000 lb. in 24-hr. orbit, launch 100,000 lb. lunar probe.



DELTA VEHICLE due for launching soon will put 480 lb. into 300-mi. orbit, carry 65 lb. as space probe (AW Nov. 9, p. 26). One planned mission is hard landing on moon.

ated within the gas and by distortion of the bag's skin.

Once the instrument package has touched the surface, the bag is split to avoid rebound. Cushions could range in size from 5 to 25 ft. in diameter, depending upon the orbital height and size and weight of the instrument package.

Actual soft landings, employing the use of retrorockets, will have to await development of the Centaur and Saturn vehicles, Rhode said.

He also told the committee that improvements in aerodynamic configurations and high-temperature materials has made development of a re-entry winged vehicle "just barely possible."

Key aerodynamic features resulting in the reduced temperatures, Rhode said, include sharply swept-back arrow-shaped wings, blunt leading edges and operation at high angles of attack.

Winged vehicle and lifting capsules are under study, Rhode said, because they can overcome many of the disadvantages of the ballistic capsule, including the very high g loads imposed when re-entering at higher-than-earth orbiting speeds, the lack of operational flexibility and need for large landing areas and extensive retrieval operations.

More Research

Rhode said, however, that the possibility of development of winged or lifting vehicles for a lunar mission will require considerably more research. He told the committee:

"Re-entry from a lunar mission is made at substantially greater than satellite speed, and the heat loads are, therefore, much higher. Unfortunately, it does not appear at present that the reduction in heat input resulting from improvements in aerodynamic shape will continue at the same rate as in the past. We must, therefore, look primarily to improvements in structure and materials to solve this problem at some indefinite time in the future."

Rhode also told the committee:

• **NASA plans to launch** a test satellite sometime this year on one of the initial Scout rockets in an effort to obtain direct and actual data on the damage that can be caused by meteoroids when striking space craft. A large amount of research already has been conducted in NASA laboratories, Rhode said, but actual experience is now needed.

The puncture-experiment satellite will have short tubes made of metal of various thicknesses, running lengthwise, and will contain gas under pressure. When a tube is punctured by a meteoroid, the gas will leak out, and radio signals will be transmitted to earth. In this manner, NASA hopes to obtain information on how long structures of different thickness can be expected to last in a space environment.

• **Different missions** require different degrees of orientation precision. The attitude of earth-oriented communication satellites needs to be maintained only within eight degrees and the attitude of meteorological satellites need to be maintained at about one degree. Interplanetary navigation, however, for space-oriented vehicles requires that the attitude be stabilized within .005 deg., and the astronomical satellite must be stabilized within .0003 deg.

• **NASA is developing techniques** for measuring the hardness of the lunar surface so that the information can be obtained when lunar impacts are made.

• **Jet Propulsion Laboratory** is developing an unmanned spacecraft for a lunar mission weighing about 700 lb. and to be launched by the Atlas Agena-B.

George M. Low, chief of NASA's manned space flight program, told the committee that a series of unmanned Atlas ballistic flights with the McDonnell Project Mercury capsules will begin during the second half of this year because of still-unanswered problems. Boilerplate version of the Mercury capsule was launched by Atlas booster last September.

Purpose of the Atlas ballistic flights, Low said, will be to test the capsule at speeds higher than those possible with the 200-mi.-range Redstone, although tests with the Redstone will begin at

about the same time as the Atlas tests and continue for approximately one year. Redstone tests include manned flight along a 120-mi. ballistic trajectory.

First type of trajectory in the Atlas test will provide "the worst possible re-entry conditions that could be attained in an aborted orbital mission," Low said. The capsule, after reaching an altitude of 140 mi., will plunge sharply back into the atmosphere, reaching a peak deceleration of 19g.

The next trajectory will be shaped to duplicate the exact velocity, altitude and angle of orbital re-entry without actually going into a satellite orbit, Low said. Purpose is to test the capsule and its heat protection under actual re-entry conditions and to determine the stability and functioning of the reaction control system.

For the third flight, the capsule will be inserted into orbit but will immediately be turned around for a re-entry. During the flight, Low said, the capsule will reach an altitude of 120 mi. and travel a distance of approximately 4,000 mi. Purpose will be to provide complete qualification of the capsule.

The first orbital flight will be at an altitude of 120 mi. and at a velocity of 17,500 mph. Each orbit will last about 90 min., Low said, and plans call for three orbits per flight for a total time of four and one-half hours.

The first capsule sent into orbit will contain only instruments to check the functioning of equipment. Later, a capsule containing a primate will be placed in orbit to check the life-support system plus biological experiments to determine the psysiological effects of long-term exposure to weightless flight. Manned flight will follow after the successful instrument and primate orbits.

Zeus Production Plea

Washington—Rep. Overton Brooks (D.-La.) asked President Eisenhower last week to release $137 million appropriated by Congress to the Army in Fiscal 1960 to begin production of the Nike Zeus anti-missile missile weapon system.

Brooks, chairman of the House Committee on Science and Astronautics, said in a letter to Eisenhower that testimony before his group "indicates there is a need for urgency in our efforts to provide additional deterrents against possible aggression." Thus far, top Defense Department officials have opposed any go-ahead on Zeus production before the system has been completely developed and tested.

Earlier in the week, Army Secretary Wilbur Brucker told the Brooks' committee that Defense also has withheld $43 million of the $253 million in research and development funds voted for the Nike Zeus in Fiscal 1960.

Eisenhower Takes Strong Stand To Defend Military Budget Policy

By Craig Lewis

Washington—President Eisenhower decided to take his stand on the defense issue directly to the public last week as leading political and military figures continued their running debate of the U. S. military posture.

The President planned to discuss defense issues during a national television broadcast scheduled for Feb. 21, the night before his departure for a tour of Latin America. He also angrily attacked his defense critics last week in his press conference.

In the Senate, Sen. Mike Mansfield (D.-Mont.) disputed Republican contentions that Sens. Lyndon Johnson (D.-Tex.) and Stuart Symington (D.-Mo.) are politically motivated in their attacks on Administration defense policy. Sen. Everett Dirksen (R.-Ill.) agreed that defense should be a non-partisan issue, but he cited Democratic statements to back his contention that the Democrats consider it an election-year political issue.

While the political dispute gained momentum, military leaders continued their congressional testimony on the Fiscal 1961 defense budget. Air Force officials indicated general support of the budget but cited certain areas where an increased effort would be desirable. Army officials outlined their accomplishments in space and made a strong pitch for a significant Army space role.

Asked about accusations that the Administration has misled the public and withheld financial support in defense matters, President Eisenhower said: "If anybody—anybody—believes that I have deliberately misled the American people, I'd like to tell him to his face what I think about him. This is a charge that I think is despicable . . ."

Eisenhower traced the history of U. S. defenses since 1950 when "in almost every field of development we were behind," and he said that, since then, the U. S. has sought "one thing—adequacy . . ." He also said he does not believe "we should pay one cent for defense more than we have to."

"But I do say this: Our defense is not only strong, it is awesome, and it is respected elsewhere," he said.

Rep. Jessica Weis (R.-N. Y.) advised the President to make a national report to the public to dispell doubt about the defense effort. He replied that evidence of such doubt puzzles him since the defense budget goes through this same process of discussion and dispute every year.

Eisenhower labeled these disputes "an intermixture of political opportunism and the perpetual military yearning for more than can be reasonably expected." He said decisions must be reached after a period of argument, and then "it comes down to deciding whom to believe—individual service proponents or people so situated as to be more objective; politically motivated people or people (the Secretary of Defense and the chairman of the Joint Chiefs of Staff are examples) who grind only the axe of doing a responsible job for the country."

Discussing the period of transition the Air Force is undergoing, USAF Secretary Dudley Sharpe told the Senate Appropriations Committee the Air Force has declined from a peak strength of 414 combat squadrons and 920,000 personnel in Fiscal 1957 to 316 squadrons and 825,000 personnel this year.

"While technological advances have helped ease the burden of these reductions, the reductions in turn have helped us to afford the vastly costlier new hardware without great increases in the defense budget," Sharp said. "How long this compressive reaction can continue is uncertain, but it is evident that its remaining potentialities should continue to be studied."

Army Chief of Staff Gen. L. L. Lemnitzer told the House Space Committee that "the Army has a vital role and interest in space." He said the Army can contribute materially to both military and non-military space efforts, and that the Army needs communications satellites and a variety of other space systems to support its current missions and capabilities.

Airborne Alert

In reference to requests by Strategic Air Command chief Gen. Thomas Power for money to support an airborne alert for his Boeing B-52 force, Sharp told the Senate group: "I don't think we differ from Gen. Power's statement. We feel we should be prepared to have an airborne alert and are preparing to have one. Exactly when we might need it remains to be seen."

USAF Chief of Staff Gen. Thomas D. White said he had requested an on-the-shelf capability for an alert identical to the one Power requested. White pointed out that Power wanted authority to fly an alert operation, while he favors only on-the-shelf capability to fly the alert Power wants.

Earlier, Gen. White told a joint meeting of the Senate Space Committee and Senate Preparedness Subcommittee that he had supported the proposal

Gen. Power made a year ago for an airborne alert. In requesting the alert program, Gen. White advised the Joint Chiefs of Staff to provide the funds under a law passed last year permitting the Defense Department to establish an alert program, then come to Congress later for the extra money to run it.

Extension of this law in a clarified form has been requested this year by USAF. Although Sen. Leverett Saltonstall (R.-Mass.) and other senators have said the law is clear in providing authority for an airborne alert, the Air Force insists it has some ambiguities and wants authority more clearly spelled out.

Gen. White said other members of the Joint Chiefs had divergent views on the magnitude and timing of the airborne alert, although he resisted committee pressure to describe these views. The views were sent to the then-Defense Secretary Neil McElroy along with the proposal, and he decided on the present limited preparations for an on-the-shelf alert capability. Although funds are being provided to buy extra engines and other spares needed to operate an alert program, USAF was told it could not have any extra personnel to implement the program.

Gen. White departed from the SAC commander's recommendations by asking only for an on-the-shelf alert capability, including training, techniques and spares. He said he feels the standby alert offers greater flexibility than an actual alert. Expense of operating an alert before it is needed was offered as another reason, along with the constant strain on crews. Gen. White also said that an alert could be considered provocative under certain circumstances.

Presently-planned airborne alert capability represents about half of what Air Force requested. It calls for $185 million in spending authority in Fiscal 1960 and 1961, and actual spending of $20 million in the current fiscal year and $90 million in Fiscal 1961. Of the $90 million, $25 million will be spent on training, the rest will go for spares. This alert capability is confined to present SAC personnel levels.

The alert capability recommended by Gen. Power would cost over $600 million for training and materiel, plus $74 million for extra personnel in Fiscal 1961, and annual costs would top $1 billion for subsequent years.

Turning to the need for a force of manned bombers such as North American's Mach 3 B-70, Gen. White outlined various advantages, including the ability to recall aircraft from an attack, the ability to carry multiple loads and usefulness in a show of force. Comparing the missile force, he pointed to the dangers of declining effectiveness stemming from the psychological factors in an immobile system. He said:

". . . I think that those crews that sit there with a blitz cloth and polish the bottom end of a ballistic missile are going to pose a real psychological problem."

Should nuclear weapons be outlawed, Gen. White pointed out that the bomber would be a much cheaper means of delivering TNT to a target than the ICBM. He also observed that if nuclear testing is outlawed, advanced missile warheads cannot be fully tested. The U.S. has considerable experience with the type of nuclear weapon that is carried by a bomber, and, Gen. White said, the manned bomber would provide a means of delivering a proven weapon.

Among the more advanced uses suggested for the B-70 was a role as a satellite launcher. Gen. White also suggested using the B-70 for shooting down satellites and pointed out that it might be adaptable to nuclear propulsion. "It need not be the first flying machine propelled by nuclear power, but it could be a very good one as we foresee it."

A major point of controversy in defense hearings has been Gen. Power's estimate that 300 ballistic missiles could destroy SAC's bases in the U.S. and abroad. Power pointed out to the Senate group that the speech containing the estimates was submitted to the Pentagon a month before it was delivered and that it was delivered in its approved form.

Col. Rodney Smith, SAC chief of operations analysis, told the Senate group that the Power estimate stemmed from a study made of conditions on Mar. 1, 1959, and brought up to date as of Jan. 19, the day the speech was delivered. He said there was little change in the results over that period, and that Gen. Power later said that, without an air alert, there would not be much change in his estimate between now and July, 1961.

Col. Smith explained that the 300 missile figure was reached by totaling the number of SAC bases an enemy would have to destroy, then multiplying by the number of missiles required to destroy each base. He estimated that it would take three missiles of the type assumed to be available to the Soviets to provide a 95% probability of destroying the soft targets at the 100 SAC bases and eliminating any nuclear delivery capability. Gen. White later called the mathematics of Power's hypothetical case "flawless."

Describing methods of dispersing SAC forces to combat this threat, Gen. White said consideration is being given to basing B-47s at civil airports. He said there are scores of civil airports in the U.S. that can handle the B-47, and he also said that a minimum installation would be built to service the B-47s if they should be assigned to civil fields.

Changing Concepts of the Cosmos—

The Sun

Man, firing the first hydrogen bomb, tapped the basic source of energy that feeds the sun and stars. Deep in its interior, the sun, in effect, explodes many billions of hydrogen bombs every second. About two million tons of matter vanish, are transformed and appear again as radiation. *Every second.*

The sun itself would explode in a flash, if it were not for the heavy overlying mass, which cushions the explosions and turns what would otherwise be a cosmic detonation into a smooth, quiet burning.

The sun has been reacting in this turbulent way for several billion years. And taking its time too; about 50 million years must elapse before the liberated energy from the explosion finally worms its way to the surface. It then reveals, to impatient earth scientists, important facts about the sun.

The sun is composed entirely of hot gas—most of it stagnant. But the outer 10 per cent rises and falls, boiling violently, making the sun appear mottled.

Here and there we see sunspots, irregular dark areas that increase and decrease in number in a cycle of about 11 years. Astronomers once believed them to be raging solar hurricanes. But recent studies indicate that the spots are islands of relative calm in an otherwise stormy ocean of seething gas. Regions frozen into immobility by the intense magnetic fields pervading the spot area.

The surrounding regions, which are violently stormy, present quite a display: weird mountains of pink flame, called prominences, soar to great heights. Geysers and jets spurt upwards hundreds of thousands of miles. Blinding eruptions of hydrogen gas form the solar flares.

All these areas—the quiescent sunspots and the cataclysmic storms—are enveloped by a deep layer of still hotter gas: the solar corona, whose edges seem to ring the sun with a halo or crown. An impressive crown it is, with a temperature of about a million degrees (Centigrade) and a breadth that embraces the earth and extends far beyond.

With a trace of royal high-handedness, the corona often disturbs the earth's magnetic field, triggers the glowing northern lights, or plays havoc with radio communications. Small vagaries in the earth's physical environment over which the sun exercises such benevolent control.

We must know the sun better. We must understand its radiation more completely,—how much, of what types, and how it distributes itself when it leaves the sun—if space travel is to become a reality.

Our present ideas about the sun, based on the best available knowledge, will undoubtedly change profoundly in the years ahead—as space probes penetrate into the coronal envelope and relay back to us pertinent information about interplanetary depths.

Because we believe that cosmography—the geography of the cosmos—will play a vital role in the future, McDonnell Aircraft has instituted important basic research in astronomy, solid-state physics, chemical kinetics and mathematics.

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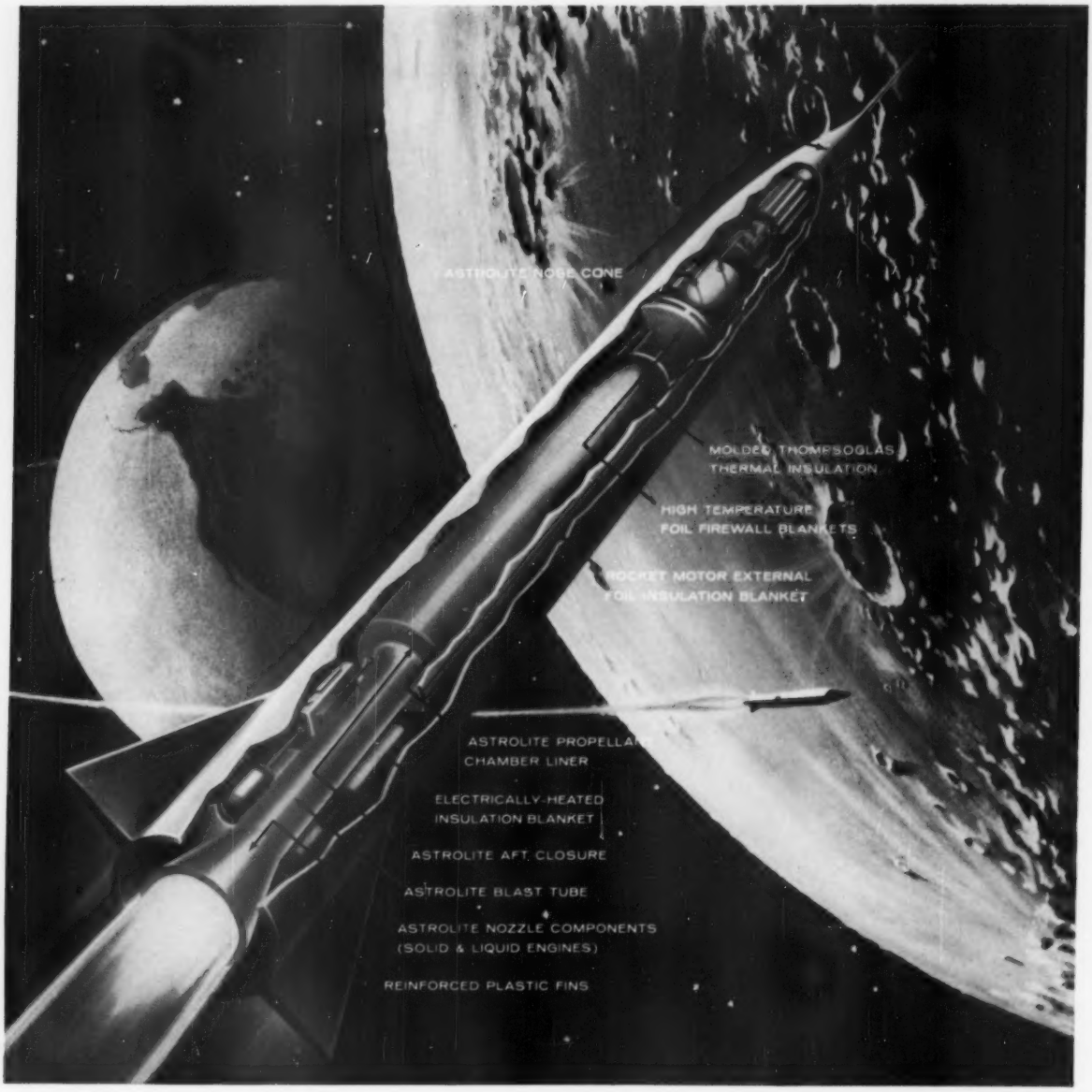
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British Key Defense Posture to Mobility

London—New emphasis on mobility and a 5.8% increase in defense expenditures—both for conventional and nuclear forces—are the major points in the White Paper presented last week by Britain's Ministry of Defense.

Mobility includes new interest in air and sea-launched missiles with possible downgrading of status of the de Havilland Blue Streak long-range ballistic missile.

The White Paper, the first issued under Britain's new Minister of Defense, Harold Watkinson, spells out no major changes in the country's defense posture under the five-year plan laid down in 1957 by Watkinson's predecessor, Duncan Sandys.

But it does contain some "shifts of emphasis"—notably in stressing the importance of conventional forces and the need for mobility.

Estimates for 1960-61 expenditures total $4,563 million as against $4,239 million last year. Discounting bookkeeping changes which transfer certain charges to the Defense Ministry, chiefly from the abolished Ministry of Supply, the real increase is approximately $246 million or about 5.8%.

Exactly where the increases are being spent won't become clear until the estimates of the individual services are revealed. But the paper gives this general breakdown of expenditures: 49% on manpower, 14% on research and development, 28% on weapons and equipment, 9% on miscellany such as training, fuel, etc.

Here's what the White Paper says on the missile question:

"One of the aims of research and development in the field of the strategic deterrent is to devise a means of delivery that is invulnerable to the opposing defenses. The development of the British ballistic missile Blue Streak is continuing.

"However, it may be decided not to rely exclusively on fixed-site missiles as the successor to the medium bomber armed with the stand-off powered bomb. Therefore, the possibilities of mobile launchers on aircraft or submarines, for the long-range delivery of nuclear warheads, are being investigated."

Government sources emphasize that no decision on adopting mobile-launched weapons has been made, and that the final decision may be to use them along with the Blue Streak.

Britain has spent an undisclosed part of a sum estimated at $1.4 billion earmarked to bring Blue Streak to "reasonable deployment." Blue Streak has been successfully static-fired and a first firing is scheduled soon at Woomera, Australia.

British are interested in both the Lockheed Polaris missile and the Douglas "Sky Bolt" air-launched ballistic missile (see p. 26). Defense Minister Watkinson is known to lean toward the air-launched type, on the grounds that its carriers could serve multiple purposes in contrast to the nuclear submarines needed for undersea Polaris firings.

Watkinson will investigate both U.S. weapons when he makes his U.S. trip, tentatively scheduled for May. Government sources maintain the decision may be to develop a new British weapon rather than buy one or both of the U.S. products, though this seems unlikely on the economics involved.

The White Paper emphasizes that currently "the V-bomber force remains the U.K.'s main contribution to the strategic nuclear power of the West." It notes that the improved engines of the Mark 2 Vulcan and the Mark 2 Victor will give the planes "better take-off performances and will allow them to fly further and at greater heights."

Without specifying how, the paper says that "the readiness of bombers in this country will be improved and their dispersal increased, and measures will be taken to make it operationally easier to deploy them overseas."

The paper also refers to arrangements being made with the U. S. for a ballistic missile warning system.

The White Paper emphasizes that nuclear power is "only one component of the deterrent," and points out that "because of the need to meet local emergencies which could develop into a major conflict, conventional armed forces are a necessary complement to nuclear armament."

Reduction of service forces will nevertheless be generally on the original Sandys schedule, dropping from 700,000 to 400,000 within the five-year period which ends in 1962.

Necessary "rapid mobility" of forces has been helped by entry of the military version of the Bristol Britannia turboprop into squadron service, the paper notes, and will be further helped by entry into service of the Britannic freighter, the Argosy, the Rotodyne and improved Whirlwind helicopters.

Paper says that English Electric Lightning supersonic fighter will enter squadron service soon.

The White Paper stresses the importance of free world collaboration in order "to maintain the efficiency of our defensive alliances at a bearable cost." The British government wants to promote wider cooperation in defense research, development and production, it says, and will work as closely as possible with the U. S., the Commonwealth, NATO and the Western European Union—in spite of the "many difficulties to be overcome."

An order for the first all-British nuclear submarine "is expected" to be placed this year, the White Paper says.

Sandys' Position on Spending

Statement by Minister of Aviation Duncan Sandys on government policy confirms the broad nature of government support long speculated in industrial circles, without disclosing any specific details.

Four point support program promised contributions toward:

- **Development and tooling costs for selected civil aircraft and engine projects.**
- **Proving and other costs involved in introducing new aircraft into service.**
- **Working capital to back speculative production targets.**
- **General aeronautical research and development work.**

Sandys also said that civil and military aircraft requirements would be harmonized.

It was revealed in the minister's statement that he originally favored the setting up of two airframe-missile groups, a helicopter group and two engine groups, which is the pattern adopted (AW Jan. 18, p. 32). "We intend to concentrate government orders on these five groups," he stressed.

Suitable arrangements would be made for the government to participate in the proceeds from sales, the statement noted. These would be shared according to the proportion of the risk taken by the government and the company concerned.

In his closing remarks, Sandys considered that the support the government was offering would enable the aircraft industry to take greater risks. "Concentrated in a small number of strong units, and adequately backed by the government, I am confident that the British aircraft industry will now be better fitted to meet the needs of modern defense and will be better able to secure its due share of the expanding market for civil aircraft throughout the world."

Although Sandys maintains that the present pattern of the industry is precisely what he advocated, it is understood that the minister would have welcomed a merger between Vickers and de Havilland which would have avoided the present conflict between the medium-range projects of these two companies.

Unidentified Satellite Tumbling In Elliptical, Near-Polar Orbit

By Evert Clark

Washington—"Silent" satellite that has been tumbling around the earth in a highly elliptical, near-polar orbit since at least December still remained unidentified late last week.

Soviet First Deputy Premier Anastas I. Mikoyan denied it was Russian, and the theory that it was a Lockheed Agena rocket stage used in some earlier Discoverer satellite launching did not seem to match the facts available on Discoverer shots.

Discovery of the non-radiation satellite first became public knowledge on Feb. 10. The so-called Dark Fence of electronic stations established across the southern U.S. last year to detect non-radiating satellites had begun to obtain inconclusive evidence of its existence as early as December, however.

This chain was developed for Defense Department's Advanced Research Projects Agency by Naval Research Laboratory. The chain is not yet completely operational, its range is limited and magnetic tapes from the surveillance network must be scanned by the naked eye. There also is still a 700-mi. gap in the center of the "fence." Navy calls the fence Spasur, from Space Surveillance System.

Navy said the tracings indicating the satellite's presence were quite "indefinite" at first and that the equipment is experimental and was operating "at extremes" part of the time in attempting to track the vehicle. One figure mentioned publicly as the outer range limit of Spasur's equipment is 1,000 mi.

On Jan. 26, Navy began to suspect it had detected something and, on Jan. 31, came to the conclusion that there definitely was an unidentified satellite in orbit, a Navy spokesman said.

On Feb. 2, the surveillance headquarters at Navy Proving Ground, Dahlgren, Va., notified the Navy Department and others of the find.

"The object did not come into view all of a sudden," the Navy spokesman said. "We would not get it every time and on some passes we would get only very faint tracings."

The satellite has a life expectancy of several months. Defense Department has not withdrawn or modified its earlier statement that the satellite "may be of Russian origin."

Mikoyan told newsmen in Cuba that "the Soviet Union has no mysterious satellite. The world knows all about our satellites."

Apogee of the unknown satellite was 1,058 mi. as of Feb. 12, and perigee was 139 mi. Period was 104.34 min., inclination of the orbit to the equator was 78.94 deg., according to the National Space Surveillance Control Center which is operated for the Advanced Research Projects Agency by Air Force's Command and Control Development Division at Hanscom Field, Bedford, Mass.

Size of the satellite is supposed to be slightly less than that of the second stage of the Thor-Agena vehicle used in Discoverer launchings. The Discoverer satellite itself is considered to be the whole 19-ft. second stage, weighing some 1,700 lb. after burnout, plus a re-entry capsule weighing up to 400 lb. Capsule is ejected from the Agena stage after an orbit is achieved.

One unconfirmed report said the object is some 20 ft. long—about the same length as a Discoverer rocket—but eight feet in diameter. This would make it approximately the size of the last stage of the vehicle that launched Russia's Mechta lunar probe on Jan. 2, 1959.

Another widely-held theory is that the object is the Agena from either the Discoverer V or Discoverer VI launching. But the Surveillance Control Center lists Discoverer V as having fallen from orbit on Sept. 28 and Discoverer VI as having fallen on Oct. 20.

Inclination of Discoverer V was 80.01 deg.—close to the unknown satellite's 78.94 deg.—but official records list its initial apogee as only 450 mi., its perigee as 136 mi. and its period as 94 min. These records also say the re-entry capsule was not recovered.

Inclination of Discoverer VI was 84.0 deg., which is believed to be too far from the unknown satellite's orbit to allow the possibility that it is Discoverer VI. Official figures on Discoverer VI give an initial apogee of only 537 mi. and a perigee of 139 mi. Capsule was not recovered.

All other Discoverers are listed by the Surveillance Control Center as having fallen from orbit except Discoverer VII, which still is in an orbit with an inclination of 80.65 deg., an apogee of 590 mi., a perigee of 125 mi. and a period of 95.6 min.

Discoverer re-entry capsule carries a retrorocket but it is not believed that this would give it the power necessary to change the capsule's orbit enough from that of its carrier rocket to account for the difference that appears between unknown object and known satellites.

The control center refers to the unknown satellite as "1960 Alpha" for the first satellite reported this year, and Navy refers to it as "Unk. 1," an abbreviation for the first unknown satellite.

Both the control center and Navy's Spasur are under ARPA's Project Shepherd, aimed at developing a satellite detection and tracking system. The Army was to have operated three CW-doppler complexes, called "Doploc," in the south central U.S., at Forrest City, Ark., Ft. Sill, Okla., and White Sands Missile Range, N. M., but these apparently have not been put into operation.

Chief of Naval Operations Adm. Arleigh Burke told a House Appropriations subcommittee on Jan. 21 that Spasur is "the detection system by which we can detect and compute the orbits of all satellites in flight. That is a very good system." A Navy statement requested by the subcommittee regarding Navy's interest in space said: "All earth orbiting satellites are under constant observation by the Spasur system, and any new earth orbiting vehicle which crosses the 'fence' will immediately be detected and added to the display pattern. The Spasur system is currently furnishing operational satellite data to the fleet, so that tactics and countermeasures can be perfected."

USAF Booster Decision

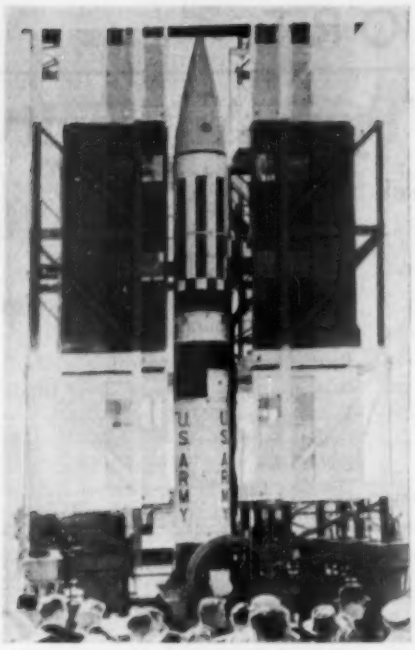
Washington—Air Force design competition for a million-pound thrust solid propellant booster has been won by Aerojet-General Corp., but no contract has yet been signed. Negotiations could continue for another month.

Total of 42 companies bid in the competition initially. This number was eventually reduced to six—Aerojet, Thiokol, Grand Central, Rocketdyne, Allegany Ballistic Laboratory and United Technology Corp.

Some of the competitors, including Aerojet, proposed segmented motors fabricated in sausage slices for ease and safety of transportation. Segments would be joined at the launch site into a complete rocket.

French Nuclear Carrier

Paris—Explosion of France's first nuclear device brings into sharp focus the still unresolved question of a carrier—aircraft or missile—to deliver the weapon now under development. The 1960 budget authorizes orders for 50 Dassault Mirage 4A strategic bombers but production decision still pends (AW Dec. 7, p. 29). Dassault claims it could begin deliveries in 1963 with final rollout in 1965, when French would have enough weapons to arm the strategic strike force. Device was exploded in the Sahara.



Army-Martin Pershing Unveiled

First photo of Army-Martin two-stage solid propellant missile (left), made during President Eisenhower's trip to Cape Canaveral, Fla., shows the present configuration, as compared with an early Pershing test vehicle (right). Test vehicle is mounted in a mobile transporter-erector. The Pershing is assembled at Martin's Orlando, Fla., facility; two Thiokol engines are static-fired at Huntsville, Ala. (AW Feb. 1, p. 24).

Vertol Shareholders Approve Boeing Pact

Vertol Aircraft Corp. shareholders have approved a plan for acquisition of Vertol by Boeing Airplane Co.

On Mar. 31 Vertol is scheduled to become the Vertol Division of Boeing, continuing operations at its Morton, Pa., location under existing management (AW Nov. 23, p. 29). Allied Research Associates, Inc., of Boston, a wholly-owned Vertol subsidiary, will report to Boeing headquarters after the acquisition. Canadian Vertol Aircraft, Ltd., of Arnprior, Canada, another wholly-owned subsidiary, will continue to report to the Vertol Division.

Out of 547,512 shares of stock included in the voting, 543,121, or 99.2%, were in favor of the acquisition and 4,391 shares, equal to 0.8%, were against the plan. Voting stock represented 81.5% of 673,093 shares outstanding and entitled to vote.

The voting shareholders authorized sale of Vertol's assets and business to Boeing in exchange for the assumption by Boeing of Vertol's liabilities, and the issue to Vertol of Boeing's capital stock at the rate of two shares for each three shares of Vertol's common stock then outstanding.

Last week Piasecki Aircraft Corp. announced that over the past year it had disposed of all its 126,630 shares of Vertol, valued at $2,700,000. These shares represented about 19% of the total shares outstanding. Equity General Corp. is believed to have exercized an option to buy them. Laurance S. Rockefeller owned 138,335 shares of Vertol (also about 19%) on Jan. 18.

USAF Boron Award Goes to Callery

New York—Air Force put boron fuels back in the limelight last week with the announcement of a $9 million contract to Callery Chemical Co. for production of pentaborane.

The fixed-price-plus-incentive contract calls for the production of 300,000 lb. of pentaborane over the next two years. The special boron fuel will be used in USAF rocket engine development program. With $9 million set as the limit, actual cost of the 300,000 lb. is expected to be somewhat less. Production will start within six months.

Counted out as a jet engine fuel with the cutback in the North American B-70 program (AW Aug. 17, p. 26), the borons now look attractive as potential rocket engine fuels. A number of companies, such as Aerojet-General, have Air Force contracts for the study and evaluation of the boron compounds in rocket applications.

News Digest

Modifications in Boeing 707 and 720 series of jet transports—ranging from 35 in. vertical fin extension, fully-boosted rudder and small ventral fin (AW Feb. 8, p. 39)—will be made on aircraft now in service, along with those in production. Kits will be furnished to present operators.

American Airlines last week reported total net earnings of $21,013,000 for the year ending Dec. 31, including $7,683,000 net profit from the disposal of property and equipment. The carrier ended 1959 with total revenues of $377,700,000, an increase of 19% over 1958. Provision for obsolescence and depreciation for the year amounted to $31,306,000 as compared with $22,901,000 in 1958.

Soviet Tu-114 turboprop transport noise tests were conducted last week at Idlewild by the Port of New York Authority. The Russians previously had declined Port Authority requests to test the Tu-114 and the Tu-104 turbojet transport, both of which have come into the New York airport under special waivers from the noise clearance required for operation there. Further tests of the Tu-114 were scheduled for Feb. 20, when the aircraft was to depart for Moscow.

Italian air force is considering purchase of the Lockheed F-104G. Representatives of the Italian government have visited Lockheed Aircraft Corp.'s facilities at Burbank, Calif., to talk with executives of the company and to tour the production area. Italy also is considering the Republic F-105 and Convair F-106.

Thiokol Chemical Corp. has completed a pre-flight rating test program on the XLR-99RM-1 liquid propellant rocket engine rated at more than 50,000 lb. thrust which will power the North American X-15 research aircraft.

Convair Division of General Dynamics Corp. received a $25,200,000 follow-on contract from Bureau of Naval Weapons for additional production of advanced Terrier missiles.

Lycoming T55-L-5 gas turbine engine, powerplant for the Vertol YHC-1B Chinook helicopter, has been uprated to 2,200 shp. from its former 1,940 shp. (AW Feb. 15, p. 120). Weight remains constant at 370 lb.; power-to-weight ratio is 3.87. Increased rating makes possible a turboprop model.

AIR TRANSPORT

British Group Urges CAB-Type Authority

Objective is agency that would encourage travel through fare cuts and aid growth of independents.

By John Tunstall

London—Need for an independent licensing authority on the lines of the U.S. Civil Aeronautics Board was stressed in a highly critical report on Britain's airline industry by the BOW group, an independent group of radical and increasingly influential members of the Conservative Party. The report also lashed out at British procurement policies and leveled serious charges against the industry's manufacturing techniques and attitudes.

Since the report was issued, a bill to set up a new board—the Air Transport Licensing Board—to be appointed by the Minister of Aviation has been announced by the government (see box). The government bill goes some of the way toward meeting the BOW group's demands.

In calling for a successor to the Air Transport Advisory Council, the report considered that this authority had failed to satisfy either the corporations or the independents. It lacked resources for independent investigation into economic and technical problems, failed to account publicly for its activities, its terms of reference favored the corporation at the expense of the airline industry as a whole, and it failed to provide control of non-scheduled services, the report charged.

The report urged that the most important directive for the new authority should be to appeal to the mass market through a policy of reduced fares and more efficient operations. In this connection, growth of the independents should be encouraged, it was said.

Parliamentary Control

Parliamentary control of the licensing authority should be exercised, the report suggested, through part-time board members, preferably four to five, appointed by the Minister of Aviation. It was emphasized that these members should have experience in economics, law, transport and labor relations. Salaries should be adequate to attract persons of high repute and they should be backed by a permanent secretariat capable of conducting its own investigations.

Hearings before this committee should be conducted in public, final decisions published, adequate supporting evidence made available, and a system of appeal for licensed applicants established.

The report insisted that the licensing authority should have jurisdiction over all air transport operations, not just the scheduled services. Included was the recommendation that all airlines should be forced to provide regular financial data and statistics by which the state of the industry could be readily assessed.

An important task facing the authority would be the need to promote growth of the independents' share of the traffic without disrupting the corporations. It deprecated the allocation of particular spheres of operations to either the corporations or the independents, and specifically did not advocate de-nationalization of the corporations. While the report recommended some reduction in the number of independent operators, it warned that such regrouping should not be taken too far.

Cost Levels

One approach advocated by the report suggested that the independents should be allowed to take advantage of their lower cost levels by granting them access to routes which were only marginally profitable to the corporations, to peak services on seasonal routes, and all low fare services.

Elsewhere outside the airlines, the report sharply criticized manufacturers of aircraft, engines and equipment on engineering grounds and soundly condemned the nation's procurement policies.

British Airline Monopoly to End

London—In a long urged "new deal" for the independent airlines, the scheduled services monopoly held since 1949 by the United Kingdom state airways corporations—British Overseas Airways Corp. and British European Airways—is to be broken.

The move was contained in the government's Civil Aviation (Licensing) Bill published last week. As a consequence, British independents are expected to grasp a larger share of increasing air traffic in and outside the U.K.

The bill sets up a new licensing authority, called the Air Transport Licensing Board, with the power of issuing licenses for scheduled and other important air services, without reference to the Minister of Aviation. All operators in the future will have equal rights to apply to the board for licenses.

In considering the issue of air service licenses, the board will take into account, among other things, need for the air transport service proposed and the extent to which proposed service would be likely to result in wasteful duplication or material diversion of traffic from any already authorized source. A board of 6 to 10 members will be appointed by the Minister of Aviation, and there will be a right of appeal against its decisions.

The Air Transport Advisory Council—which hitherto has advised the Minister of Aviation what new scheduled air services should be authorized—is to be scrapped.

BOAC and BEA monopoly rights over scheduled services were granted under Section 24 of the 1949 Air Corporations Act, and this section now is to be repealed.

In recent years, independents have been able to run some scheduled services, chiefly domestic, but only under the guise of "associates" of BEA and BOAC.

New system of licensing to be set up under the bill generally is aimed at tightening up on safety requirements. Operators engaging in operating air traffic for hire or business will, under the new regulations, have to obtain an Air Operator's Certificate, issued by the director of aviation safety, and, with some exceptions, an Air Service License, issued by the Licensing Board. Currently, companies running non-scheduled and charter services are outside the system under which applications for licenses to operate a scheduled service go to the Air Transport Advisory Council and are referred to the director of aviation safety.

Commenting on the bill, BOAC Chairman Sir Gerard d'Erlanger stressed the "tremendous investment" and "vast knowledge" of the state airline, and added "if opportunity is afforded to the independents also to compete with us, it is essential that this shall be on equal terms."

Its most serious accusations were directed against the Interdepartmental Aircraft Requirements Committee, later the Transport Aircraft Requirements Committee (TARC).

This committee, the report noted, not only failed to anticipate the large turbojet transports, but more recently was widely condemned for its recommendations concerning a supersonic airliner project which, the report charges, "were commercially unrealistic."

Procurement Mistakes

Persistent procurement mistakes which, according to the report, characterized British postwar air transport policies, were considered to be due to the influence of the Ministry of Supply, whose members dominated TARC committees and subcommittees.

"Airline procurement, the future of the manufacturing industry and the needs of the armed forces," the report stated, "are so tightly linked together that there is certainly a need for a central forum such as TARC. However, it would seem in practice that the machinery failed in the past for lack of members of the right caliber and for lack of leadership. This can partly be solved by the personal activity of the new aviation minister. But it will also be necessary to draw in some way on the services of those who are more aware of the economic intricacies of international air transport and who occupy positions of authority within the operating and manufacturing industries."

As a further example, it noted Britain's failure to use air transport for logistic air freighting, in the U.S. fashion. As far as is known, the report stated, the British military authorities have not really investigated whether or not the same supply tactics would be practical.

The report concluded with a particularly gloomy picture of the immediate future now facing the industry's principal project. Its authors saw little future for either the Vickers VC.10 or the de Havilland 121, which it was argued will be too quickly outdated by supersonic aircraft.

Because of its speed, they saw even less future for the Vickers Vanguard unless and until international agreement on lower fares was achieved.

Short-Haul Transport

On the other hand there were "powerful technical reasons" why Britain should develop a supersonic short- to medium-haul airliner with some priority, and leave the long-haul intercontinental supersonic aircraft to U.S. operators.

"To drop out of the supersonic race at this stage would prevent the British aircraft industry from participating in the extensive market that will have developed by the end of the century," the report continued.

Not the least of Britain's problems, it added, were due to engineering shortcomings. It recommended "a sharp improvement in the general level in industrial engineering" if Britain was to take advantage of its relatively low labor costs. With more attention to production engineering, British aircraft should be less expensive, not the same price as their U.S. counterparts.

The report noted lack of attention to maintenance, reliability and interchangeability factors. "A degree of attention to engineering detail quite unknown to some British manufacturers is needed."

The report is entitled "Wings over Westminster—Britain's Airlines in the 60's."

It was edited by Tony Lucking, a 34-year-old management consultant who was backed by co-editors associated with the airlines.

Western Orders Boeing 720; Announces Plan to Lease 707

By Robert H. Cook

Washington—Western Air Lines last week announced a purchase agreement for three Boeing 720 jet transports for delivery in 1962, with an option for a fourth by the end of 1962, and plans to lease two 707s for use on its present routes.

Details of the carrier's jet equipment plans highlighted Western testimony before a Civil Aeronautics Board hearing on the Trans-Pacific Case, in which Western is seeking new routes between the U. S. mainland and Hawaii.

Western spokesmen said an additional option for the purchase of five more 720s in 1962 will be exercised if the CAB grants its request for a new route connecting Hilo and Honolulu with San Francisco, Los Angeles and San Diego.

Lease terms completed with Boeing cover a one-year period and are renewable in six-month segments, according to Western officials. The two aircraft are scheduled for delivery by early May and will be used initially to meet the airline's jet competition along the Pacific Coast.

Purchase and option agreement on the four other Boeings calls for deliveries in April, May and June of 1961 with an option on the fourth for delivery by the end of the year.

The added option for five more 720s, in the event Western is awarded routes to Hawaii, provides for deliveries at the rate of one aircraft a month, the airline said.

Boeing said the two aircraft being leased to Western are the same 707s formerly scheduled for delivery to Cubana Airlines. Unable to raise the necessary financing to complete the purchase, the Cuban carrier was forced to forfeit down payments on the aircraft but told Boeing that it still hopes to purchase 707 jets in the future.

Western spokesmen said the leased models are particularly suited to the airline since they have been designed for overwater service and could immediately be placed on a Hawaii run if Western is awarded new routes in the Trans-Pacific Case.

Financing to cover the purchase of the first four Boeing turbojets plus six Lockheed Electras, which Western has purchased under a prior option for delivery in March, April, July and August of this year, is being arranged as part of $21 million financing program.

Funds will be raised through the issuance of 200,000 shares of common stock and the acquisition of long term debt.

Calling attention to Hawaii's rapid tourist growth, Western President Terrell C. Drinkwater told a CAB hearing examiner that a personal survey of the island's projected tourist potential indicates a growth rate far beyond current estimates and in sufficient volume to warrant Western's requests as well as those of other applicants for increased jet service.

Drinkwater also recounted Western's need for long haul markets and told the Board the Trans-Pacific Case should follow CAB philosophy of strengthening smaller trunkline route systems.

In addition, Drinkwater said the Hawaiian stop is needed to tie in with Western's current Los Angeles-Mexico City routing as competitive protection against expected foreign carrier service between Hawaii and Mexico.

Drinkwater declined to name an airline for selection to provide nonstop service from Chicago and points east to Hawaii, but told CAB that Western anticipates that such a service will be granted. In the event Pan American or United is authorized to provide this service, he said the selection should strengthen Western's case since such an operation would tend to decrease the volume of service they might provide from Western points along the Pacific Coast.

Contending that Western is the logical carrier to provide new air service to Hawaii because of its route system

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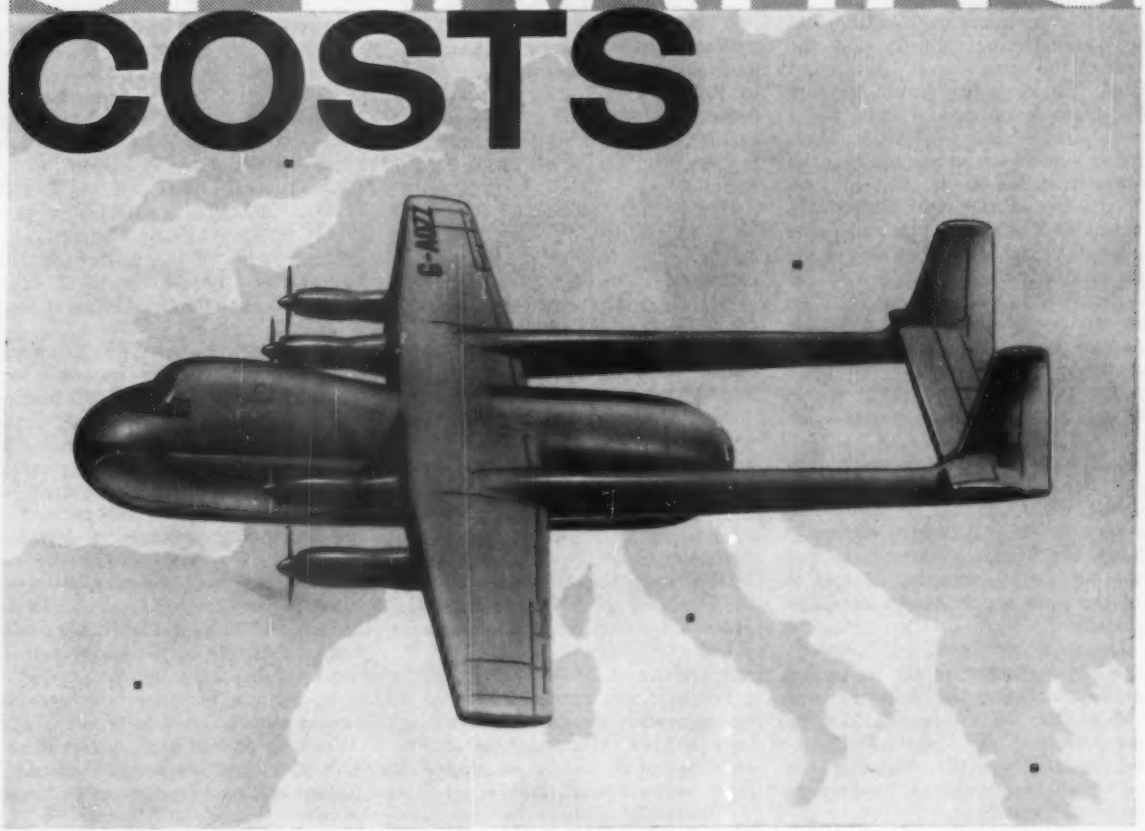

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THE ARGOSY BRINGS THE COST OF AIR FREIGHT DOWN TO EARTH

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which blankets most major cities in the West, Drinkwater said Hawaii-bound traffic could funnel into San Francisco and Los Angeles on Western jet flights from such distant points as Minneapolis/St. Paul and such heavy population centers as Denver and Salt Lake City. Western also has asked for the inclusion of San Diego on the Hawaii routing since it is now the only major Pacific Coast city lacking this service.

Initial service from San Diego would be on a daily basis to Hawaii during the peak summer tourist season and twice weekly for the balance of the year, Drinkwater said.

The airline president told the Board that tourist volume to Hawaii would be increased further by Western's plans to establish joint first-class fares with Hawaiian and Aloha airlines to permit passengers traveling from the mainland to make a stopover at Hilo at no extra charge. Drinkwater added that because of CAB's investigation into fares charged to the outer islands and a personal belief that they might later become separate destination points, Western intends to provide only two flights a week to the "Big Island" pending a traffic buildup.

Drinkwater also expressed concern that foreign carriers operating a Hawaii-Los Angeles-Mexico City route might severely handicap Western's operations into Mexico City if the airline's trans-Pacific application is denied.

Tracing the progress of foreign airlines in this market, Drinkwater said Real Aerovias, the Brazilian carrier, has announced plans to inaugurate service from Rio de Janeiro to Mexico City and then Los Angeles to Honolulu and beyond. More foreign competition over a Hawaii, California, Mexico City routing also could result if Philippine Airlines exercises existing bilateral agreements with this country, Drinkwater said. He said that Japan Air Lines might seek to add Mexico City to its present Tokyo, Hawaii, Los Angeles route.

Drinkwater told the Board that the requested Hawaiian route pattern, ranging from 2,400 to 2,600 mi. from the three West Coast cities, would be "ideal" since it would increase the airline's average flight stage length beyond the 1,000-mi. range considered necessary for economical jet operations.

FAA Says Decca Fails Helicopter Trials

Washington—Decca Mark 8 navigation system in its present design fails to meet the Federal Aviation Agency's standards for a primary IFR system for helicopter use, the agency concludes following a year of flight evaluation in the New York area with its own and New York Airways helicopters.

FAA says the Decca Mark 8 lacks the operational reliability and ease-of-use required and that its demonstrated accuracy "was well below the high accuracies stated in published descriptions of the system and delineated in theoretical accuracy contours."

The report, prepared by FAA's National Aviation Facilities Experimental Center, states that "within the accuracy and other operational and technical limitations described . . . Mark 8 may be useful as an en route aid for low flying IFR helicopters in certain areas, provided that:

- **Operations are restricted** to fixed air-carrier type routes between pre-selected terminals so that the pre-selected plotter chart would contain the position-recording pen during the entire flight.
- **Operating area lies within** a favorable portion of the system's hyperbolic coverage.
- **Plotter charts are constructed** carefully from a very large number of actual receiver readings made in the areas to be flown.
- **Two pilots are in the cockpit** so that the required close attention can be devoted to the navigational equipment.
- **Dual Decca equipments** are carried to provide reliability needed for a primary IFR aid.
- **Other navigation aids** and services are available for supplemental use.
- **Fail-safe features** are added to alert pilots to erroneous meter or plotter indications.

The FAA tests intended to evaluate the usefulness of a low-frequency hyperbolic navigation system for helicopters included 3,000 hr. of operational use of Decca by New York Airways helicopters and about 700 hr. of specialized test flying in an FAA helicopter.

Fixed-Wing Decca Tests

The FAA also released the full report on its evaluation of the Decca Mark 10 system as a fixed-wing aircraft navigation aid. Test results were first disclosed by AVIATION WEEK (Jan. 4, p. 27; Jan. 11, p. 33). The Mark 10 is a more fully automatic version but slightly less accurate than the Mark 8.

In its conclusions, the FAA report said that when the Decca Mark 10 is working properly, it provides easy-to read general orientation and track history data. However, it failed to meet FAA's criteria for a primary IFR navigation aid for the following reasons:

- **Does not provide steering** information, forcing pilots to resort to other navigation aids.
- **Two pilots are needed** to operate the Decca equipment and operate the aircraft in many air traffic control situations.
- **Charting problems limit** the system to air carrier-type operations over fixed routes. If substantial deviations from these routes are required, separate charts are needed.
- **Operational reliability** was below acceptable standards for a primary IFR aid.

The FAA report also said that the Mark 10 is somewhat easier to manipulate than earlier versions "but is still cumbersome to operate in comparison with today's standard IFR primary aids."

FAA's fixed-wing Decca tests were more limited than its helicopter evaluation, with a total of about 351 flight hours accumulated by seven "highly qualified pilots." Prior to flight evaluation, each pilot received a minimum of 12 hr. of flight familiarization and 6 hr. of ground instruction, according to FAA.

In the fixed-wing evaluation, 11 to 15 round trip flights were made over each of four selected routes: Idlewild to Washington and Atlantic City; Idlewild to Phillipsburg, N. J., back to Idlewild over a different route; Idlewild to Montreal to Albany and back to Idlewild, and Idlewild to Boston and back.

After each flight, the pilot was asked

Pilots Seek Duty Cut

Pan American pilots have advised their company that as of Mar. 16 crews will not accept flights involving more than eight hours of flight deck duty. Company has responded that pilots who refuse such flights will be "subjected to appropriate disciplinary action." Only piston equipment is at issue, for an eight hour flight deck duty limitation covering pilots on jets was written into the Feb. 4, 1959, agreement between Pan American and the Air Line Pilots Assn. Pilots contend that multi-leg flights of more than eight hours block-to-block time result in excessive fatigue and endanger the lives of crew and passengers. They accuse the company of using unrealistic schedules that call for flights of up to 11 hr. 59 min. in duration. Company argues that the flight deck duty limitation was raised at the bargaining table and then dropped by the pilots in exchange for other company concessions. Pilots' union "must know that it cannot arrogate to itself the power to impose new contract terms on the company," Pan American wired the PanAm pilot union Master Executive Council.

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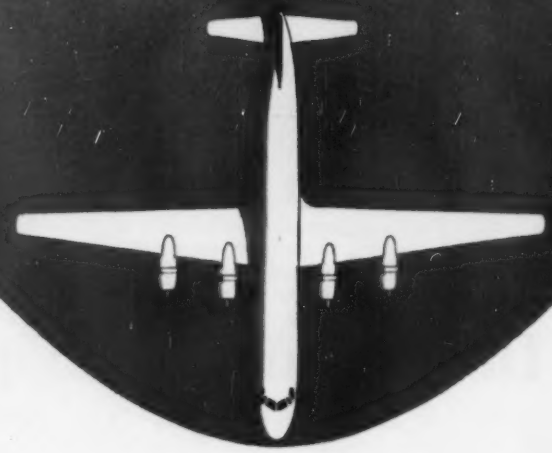

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to fill out a questionnaire, and the Decca inked flight log chart was removed for analysis. Following is a summary of pilot comments: (Where figures do not total 100%, the balance represents lack of pilot comment.)

- **Were there discrepancies** between Decometers and flight log after referencing? 24% yes; 64% no.
- **Did any discrepancies occur** between Decometers and flight log during flight? 40% yes; 47% no.
- **Were there any unaccountable** excursions of the flight log during flight? 52% yes; 35% no. On the ground? 10% yes; 47% no.
- **Did the zone identification** work properly? 48% yes; 37% no.
- **Did the flight log** require resetting, or present difficulties, when entering a Decca area? 29% yes; 21% no. In fringe areas? 39% yes; 31% no. In changing charts? 47% yes; 29% no. In changing Decca chains? 18% yes; 31% no.
- **Were you able to comply** with ATC clearances while using Decca? 34% yes; 50% no.
- **Were you able to stay within** omni-airway structure nine miles? 23% yes; 62% no.
- **At any time were you unable** to hold within prescribed holding patterns? 18% yes; 42% no.
- **Were you able to navigate** by use of Decometers only? 28% yes; 35% no.
- **Were you able to use Decca** without resource to another navigation aid? 25% yes; 49% no.
- **Did the flight log** geographical presentation cause difficulties at any time? 21% yes; 57% no.
- **Did route diversion cause** a restriction in the use of flight log at any time? 13% yes; 52% no.
- **Did you find initial setting** up of equipment to be difficult? 56% yes; 21% no.
- **Did you believe equipment** to be operating improperly at any time? 40% yes; 34% no.
- **Did you find it possible** to home on reporting points off the printed airways? 48% yes; 5% no.
- **Did operation of Decca equipment** make it difficult to carry out other cockpit procedures associated with your flight from two-pilot IFR operation? 48% yes; 11% no. From single-pilot operation? 56% yes; zero % no.

Humidity and temperature, rather than visibility, are the chief weather factors which hamper performance, Cummings said.

Next round of equipment planned for New York Airways is the 65-passenger Fairey Rotodyne VTOL, which Cummings said would be available in late 1964 and for which the airline has signed a letter of intent to buy. Cummings said the Rotodyne has a noise problem, which he is convinced is of a metallurgical nature and which he is sure Fairey will solve. "But they'll have to solve it before we'll touch it," he added, and said the manufacturer is "well aware" of this fact.

Vertol Studies Third-Turbine 107

New York—New York Airways may retrofit its newly-ordered Vertol 107 twin-turbine helicopters (AW Jan. 18, p. 41) with a third engine if needed for all-weather operation.

Robert L. Cummings, president of the helicopter airline, said the additional powerplant might be needed for zero-zero operation, although he hopes it won't. The 25-passenger rotorcraft will be equipped with General Electric CT58-100 turboshaft engines. New York Airways expects to receive five 107s for service by spring, 1961, and a final five by the end of 1963.

Price of the 107s, Cummings said, totals about $9 million for the fleet of 10, at about $½ million per airframe and $62,000 for each engine, plus spares.

The order involves a trade-in arrangement with Vertol covering the airline's present fleet of five Vertol 44B 15-passenger helicopters. Vertol expects to sell the used 44Bs without difficulty, according to President Don R. Berlin, who said there is an adequate market for them in other countries. Cummings said New York Airways itself had had some inquiries concerning possible purchase of the 44Bs "that look pretty real."

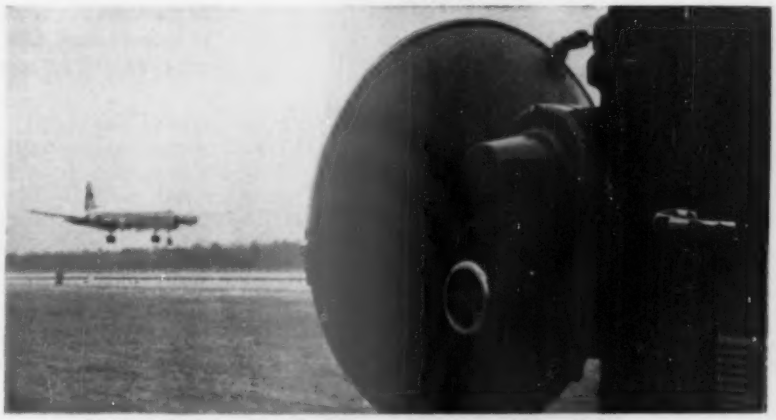
With the first five Vertol 107s in operation, New York Airways can reduce its subsidy requirements to a quarter of what they are now, Cummings said—assuming the airline is given the route structure it wants. When all 10 Vertol 107s are flying, the airline should be able to operate 55 million seat miles a year and to go off subsidy, Cummings said.

With the new aircraft, New York Airways should be able to reach an operating performance factor of 85-90% at a "conservative minimum," Cummings said. Performance factor now averages about 78% annually, with a low of 65% during some months.

MATS Short-Term Contracts Awarded

Call contracts totaling $1,770,290.27 this month were awarded to nine airlines by Military Air Transport Service. Under the agreements, which are awarded periodically by MATS to meet the military's short-term transport needs, the carriers will move about 10,100 passengers and 800 tons of military cargo along Atlantic and Pacific overseas routes during February.

Contracts, awarded on Feb. 5 and 6 but made public by MATS last week, were to the Flying Tiger Line, Inc., for $513,917.47; Seaboard & Western Airlines, Inc., for $363,385.18; Capitol Airways, Inc., for $286,756.02; United States Overseas Airlines, Inc., for $205,832; Twentieth Century Airlines, Inc., for $165,525; Overseas National Airways, Inc., for $123,092; Los Angeles Air Service, Inc., for $51,300; Trans Caribbean Airways, Inc., for $39,388.80; and Trans World Airlines, Inc., for $21,093.80.



FAA Tests Bell Aircraft Landing System

Federal Aviation Agency Douglas C-54 laboratory aircraft is landed automatically throughout final approach and touchdown by all-weather automatic landing system developed for USAF by Bell Aircraft Corp.'s Avionics Division. System, being evaluated at National Aviation Facilities Experimental Center, Atlantic City, N. J., uses radar to track airplane and radio to transmit control instructions to aircraft's automatic pilot.

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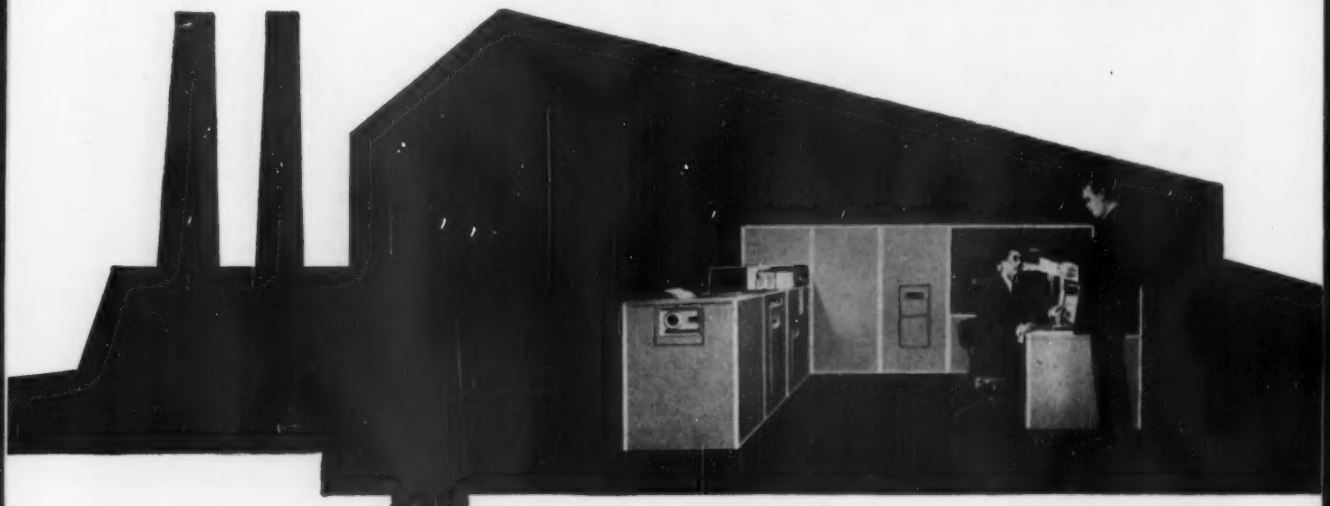

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West Indies Status May Affect Routes

By William H. Gregory

Dominion status for the West Indian Federation and independence for British West Indian Airways which are likely to come in 18 months or two years may bring with them some changes in airline route patterns in the Caribbean.

Independence of the airline, whose shares now are 100%-owned by British Overseas Airways Corp., depends not only on the attainment of dominion status by the Federation but also on whether the Federation will be willing to acquire the airline from BOAC for operation as a national carrier.

Despite some bickering among the islands—especially from Jamaica as the largest in terms of population—U.S. government and airline sources believe the Federation will become a dominion in the British Commonwealth and that it will put up the capital to make the airline West Indian-owned.

Underscoring this belief is the search by British West Indian Airways for jet equipment. Significantly, 18-month delivery is an important element in the order.

H. O. B. Wooding, BWIA chairman, recently finished a tour of West Coast manufacturers. Other officials of the airline are continuing negotiations. A decision is expected in the next two months.

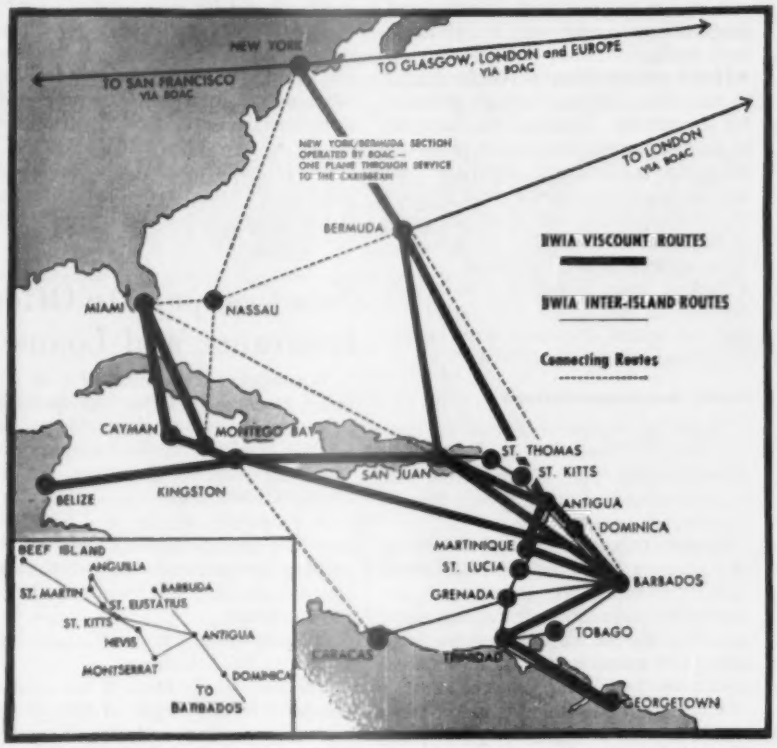
Transatlantic capability for the airline's Jamaica-New York-London route (not yet being operated) is necessary, although a long-range jet transport would not be required for Caribbean-U.S. routes. The Convair 600 was reported favored in early stages of the studies (AW Jan. 4, p. 34).

British equipment also is being considered, but the order is almost certain to go to the U.S. Longer delivery dates for long-range British jets is the prime reason.

Leased transports might be used in the meantime on BWIA's only other route to New York—perhaps Douglas DC-7s or Bristol Britannias. This route is now flown by BWIA Vickers Viscount 702s from Trinidad and Barbados to Bermuda. From Bermuda to New York, the route is flown as a BOAC flight, handled as a charter of BWIA equipment.

The Federation, looking toward its future status, has won acceptance of its request to sit in on the U. S.-United Kingdom bilateral talks which begin in Barbados this week.

U. S. airline sources are not so much concerned that the U. S. will face any direct conflict in the Caribbean. But there is some fear that there may be a repetition of previous cases where the U. S. has traded with Britain for rights in British possessions and then found it had to trade all over again for the same rights when the former colony attained independent status.



BRITISH WEST INDIAN AIRWAYS Viscount routes and Douglas DC-3 routes (light lines) are supplemented by de Havilland Herons operated by Leeward Island Air Transport, a subsidiary, to islands with airfields too small for the larger aircraft.

Wooding told AVIATION WEEK that he personally would like to see a BWIA route into Mexico City, where a link could be made with a U. S. carrier such as Western Air Lines. Otherwise he would not discuss what route plans the airline might be officially formulating.

Reciprocity undoubtedly will be a sensitive point with BWIA. Two cases in point are cited by BWIA officials:

• **KLM Royal Dutch Airlines** is regarded by BWIA as one of its principal competitors of the 16 airlines serving various islands in the Caribbean. Yet BWIA does not have routes to the Dutch islands of Aruba and Curacao in the Caribbean let alone to the home country.

• **Trans-Canada Air Lines** serves Jamaica, Antigua, Barbados and Trinidad from both Toronto and Montreal. BWIA in turn has traffic rights into Montreal, an agreement made by the British. But Toronto, BWIA contends, generates 80% of Canadian traffic into the West Indies.

Canada is interested in the West Indies and more than a year ago was negotiating for a merger of Trans-Canada Air Lines and BWIA. The plan foundered over an issue important to the islands: TCA wanted to consolidate all maintenance at Montreal, which would have meant closing BWIA's main base at Port of Spain, Trinidad, and the loss of jobs held by West Indians.

Canada recognizes potential for future trade in the area, however, and closer ties are likely. Meat comes to the Caribbean all the way from Australia and New Zealand now because of Empire trade agreements. Canada needs West Indian sugar, however, and has cattle much nearer at hand for the islands. Another source of possible business traffic for BWIA is bauxite, the ore that goes into aluminum. Besides deposits in Jamaica within the Federation, there are major supplies in British Guiana. BWIA serves Georgetown, British Guiana and operates British Guiana Airways for the British Guiana government.

Because of its geographic position, the Federation has some natural advantages in stage lengths for breaking jet flights between North and South America. BWIA is interested in the South American market, but has been cautious on entering it up to now with the fare-

cutting problems that have existed.

Tourist traffic is the prime source for BWIA and its Miami-Jamaica route is now its key revenue stage. Two related programs are under way to stimulate such traffic:

• **Hotel construction** is being sought by the various islands through generous tax concessions. Trinidad, for example, is permitting duty-free import of all the necessary construction materials, an income tax holiday for the first 10 years of operation and in each of any five years of the eight following the tax holiday a 20% writeoff of the hotel cost.

• **Package tours,** including a tie-in with Greyhound Bus Lines, and various on and off season excursion fares in the Caribbean offered by BWIA.

Hotel Accommodations

Hotel accommodations and air fares are mutually important in an economy where tourists play a major role and representatives of each group keep a close watch on the other.

A recent example was the opening of a route to Aruba by Trans Caribbean Airways in which the airline was guaranteed a minimum hotel accommodation for its passengers that is large enough to assure it that most will have no trouble in finding places to stay.

BWIA stresses island-hopping tours which take advantage of stopover privileges. During the busy winter season, BWIA offers a five-island tour from New York to Bermuda, San Juan, St. Thomas, St. Kitts, Antigua and return for $203.60, the same price as a New York-Antigua round trip. Similarly the airline offers a Miami trip to Grand Cayman, Montego Bay and Kingston, Jamaica; San Juan, St. Thomas, St. Kitts, Antigua and return for $159.80, the same as the Miami-Antigua round trip fare.

In the summer off-season 17- and 30-day special excursion fares will cut $20-$30 off regular round trip fares. Some island-hopping trips are offered with a direct return from the last island visited or a return via the same islands.

The airline finds it to its advantage to keep the tourist moving fairly rapidly. If an island stay lasts over three days, the traveler tends to settle there for the rest of his trip, costing the airline traffic.

Inter-Island Traffic

Inter-island traffic is fairly brisk—in slightly less than a month last year Leeward Island Air Transport carried 2,123 passengers in and out of its home base at Montserrat, mostly to Antigua for shopping—but it is not yet a profitable operation in general for BWIA. This is a factor Wooding hopes the Federation will recognize.

If the Federation wants BWIA to serve low density routes such as that from Barbados to Belize in British Honduras, Central America, in the Federation's interest, then he feels such routes should be subsidized.

BOAC has been divesting itself of various subsidiary airlines throughout the world and BWIA sees no problem in coming to an agreement with BOAC if independence is decided. BWIA is known to have been irked by BOAC's latest annual report which blamed its losses on its subsidiaries' operations, but is taking care not to be drawn in any controversy over the issue.

New Company to Offer Insurance and Loans

Washington—Organization of a group of companies that will specialize in insurance and consumer finance for aviation employes has filed a registration statement with the Securities and Exchange Commission.

A proposed offering of 2.5 million shares of voting common stock by the holding company of the group, Aviation Employees Corp., was included in the statement.

Offering price will be $2 per share subject to SEC clearance.

Officers and directors of the holding company consist largely of top officials within the aviation industry. Executive officers are Samuel J. Solomon, president and director, former chairman of the board of California Eastern Aviation and president and chairman of the board of Northeast Airlines; Richard Fell, vice president and director, now general manager of Butler Aviation in Washington; Paul Brabason, vice president, former eastern representative for Erwin-Newman Co., and Joseph Greenwood, corporation secretary and general counsel.

Directors are: Emory F. Johnson, president of Air Cargo, Inc.; Joseph P. Adams, executive director and general counsel of the Assn. of Local Transport Lines and former Civil Aeronautics Board member; Richard S. Boutelle, technical consultant to General Motors Corp. and former president of Fairchild Engine & Airplane Corp.; Paul H. Brattain, former first vice president and director of Eastern Air Lines; Frederick M. Glass, senior vice president and vice chairman of the board of directors of the Empire State Building Corp.; David R. Grace, a partner in Sterling, Grace & Co.; Thomas O. Hardin, Maj. Gen. USAF (ret.); Alexander G. Hardy, senior vice president of National Air Lines; Arthur C. Hyde, commercial real estate developer; Charles A. Rheinstrom, vice president of J. Walter Thompson Co.; Kenneth Stiles, vice president of General Dynamics Corp., and John B. Walker, president of Walker & Crenshaw.

Flight Engineers Elect New Top Executive

Washington—Flight Engineers International Assn. last week announced the election of Ronald A. Brown as president of the 3,600-member union for a two-year term. Election of the new president, who has served as acting head of FEIA since the resignation of George R. Petty, Jr., last August, took place at a recent meeting of the union's Master Executive Board in New York City.

Also elected to office were Harry S. O'Brien, executive vice president; Boyd S. Moore, technical vice president, and Henry J. Breen, re-elected secretary-treasurer.

A native of Kearney, Neb., Brown has been a vice president of the union for the past three years and, prior to that, was employed for eight years as a flight engineer on United Air Lines. His past experience also includes World War II combat experience as a flight engineer on Boeing B-17s in the European theater of operations as well as field service mechanic duties with Douglas Aircraft Co.

Flying Tiger Obtains Labor Injunctions

Washington—Flying Tiger Line hoped to return to normal operations late last week after obtaining court injunctions against pilots and engineers who had honored picket lines thrown up by the airline's navigators.

In addition, the airline also filed damage suits of $6 million against the Transport Workers Union representing the navigators and the Air Line Pilots Assn., charging that the two groups had violated provisions of the Railway Labor Act in picketing activities.

Primary cause of some concern, an airline spokesman said, centers around continuing negotiations with TWU over the status of 14 navigators hired by the airline at a time the union was threatening a strike against the company.

The new navigators, who are not members of TWU, were guaranteed six months of employment by the airline before TWU successfully concluded its contract negotiations.

Suits against ALPA and TWU were filed by the airline after the navigators' union picketed Flying Tiger operations. ALPA members and some engineering personnel also refused to cross the picket lines.

A federal district court in Newark, N. J., ordered ALPA members to continue flying for the airline, while a Los Angeles County Superior Court handed down an injunction ordering the flight engineers to return to work.

SHORTLINES

► **British Overseas Airways Corp.** operations into Cairo after a three and one-half year suspension (AW Feb. 15, p. 50) will begin on Apr. 10, with four round trips per week using de Havilland Comet 4 turbojet aircraft.

► **Civil Aeronautics Board** last week ordered an investigation to determine whether American Airlines, United Air Lines and Trans World Airlines should be granted rights to operate nonstop service between Detroit and Los Angeles and Detroit and San Francisco/Oakland.

► **Continental Air Lines** and five major highway trucking lines have agreed to operate through freight shipments on one joint air-truck bill of lading at a single through rate. The plan, which has been approved by both the Civil Aeronautics Board and the Interstate Commerce Commission, connects 174 off-line cities with Continental's air terminals in Colorado, California, Missouri, Oklahoma, Kansas, Texas, New Mexico and Illinois.

► **Eastern Air Lines** plans to continue its $45 one-way, $90 round trip fares between New York and Puerto Rico despite a decision by other airlines to discontinue the special rates. Eastern, however, will discontinue discounts on the round trip special fares effective Mar. 15. Other carriers on the route will raise fares to $52.20 one way on Mar. 15.

► **Lockheed Aircraft Service** has received a $1 million contract from Eastern Air Lines to convert five Lockheed Super-C Constellations from passenger to all-cargo configuration. Work is being carried out at Ontario, Calif.

► **Mohawk Airlines** and the Air Line Dispatchers Assn. signed a new three year work contract agreement last week. Negotiations between the local service carrier and the union required less than three days although a major portion of the existing agreement was rewritten.

► **Trans World Airlines** plans to absorb transcontinental $10 jet surcharges for passengers who are ticketed on TWA's European turbojet flights. TWA will absorb the surcharges on its own flights as well as the surcharges on transcontinental flights operated by American Airlines and United Air Lines when the passengers are ticketed to or from New York on one of TWA's transatlantic flights. On Mar. 1, TWA also will absorb the transcontinental jet surcharge for passengers transferring to or from the airlines' piston engine transatlantic flights.

AIRLINE OBSERVER

► Watch for a move by American Airlines to convert its remaining fleet of Douglas DC-7s to Rolls-Royce Tyne turboprop power for passenger service. The carrier now has 18 DC-7s in its passenger fleet inventory; 10 others have been converted by Douglas to all-cargo aircraft.

► **Braniff Airways decision to buy either Boeing 720 or Convair 880 turbojet transports (AW Feb. 15, p. 41) has been postponed until President Charles Beard returns this week from a nine-day tour of South America in a Boeing 707-227 with more than 50 leading government, business and news media executives. Although the earlier announcement said Braniff is interested in adding three of either type to its fleet, indications are that negotiations will embrace up to nine of the 702s or 880s.**

► Airline traffic continued to climb at a spectacular rate during January despite the highly-publicized accidents during the month which apparently had little or no effect on business generally. Revenue passenger miles reached 2.41 billion—a 17% increase over January, 1959. Although the comparison is not entirely realistic because of the effect of industry strikes on capacity in January of last year, the showing is the third best monthly result in airline history. Load factor for the month was 59.59%.

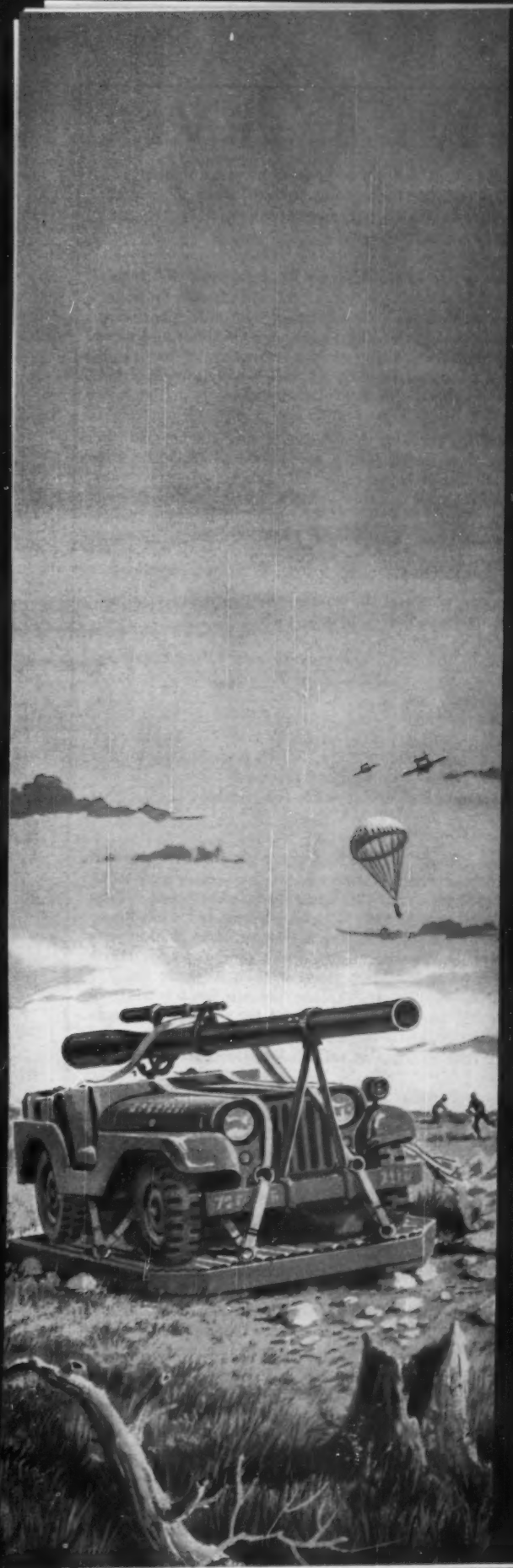
► **Trans Caribbean Airways is studying the Convair 600 turbofan transport for possible operation on its New York-San Juan route.**

► East Germany reports it is well along in the development of a turboprop transport to replace the 26-passenger piston-engine Russian Il-14 now being built in Dresden. New aircraft may be the same one mentioned last summer by Brunolf Baade, designer of the East German BB-152 turbojet transport (AW Dec. 14, p. 114). Baade said that his design team had begun work on a "new type of plane" and indicated that the aircraft probably would be a twin-jet passenger transport for short and medium-range operations. He said the plane would be more economical than the BB-152 and have a somewhat lower cruising speed.

► **Indications are that the Boeing 727 medium jet transport with a 65-88 seat configuration is approximately three years off, the time considered necessary for the development of its 10,000-lb.-thrust turbofan engines. Four manufacturers—Pratt & Whitney, Allison, General Electric and Rolls-Royce—have indicated their interest in participating in the project. Boeing feels the Model 727 design is sufficiently advanced to beat a similar-class de Havilland transport into service by at least two years. Design work on the 727 has been under way for about four years. Airplane basically has a fuselage of the same diameter as the 707 model; length is about the same as the Lockheed Electra. Main landing gear will retract rearward into engine nacelles projecting from the wing trailing edges as on the Russian Tu-104 turbojet.**

► Paris Airport Authority is considering a new airport for the Paris region that would replace Le Bourget by 1975. Called Paris-Nord, the projected airport would be built at a cost of approximately $100 million. It would be located beyond present Le Bourget site, should double the distance from the center of Paris. Paris-Nord would share Paris air traffic with Orly. Paris Airport Authority estimates air traffic into the two airports will be about 10 million passengers in 1975, 12 million in 1980. In 1959, the two airports of Orly and Le Bourget handled a total of almost three million passengers.

► **Britain reportedly is exerting behind-the-scenes pressure on some member nations of the International Civil Aviation Organization in an effort to block adoption of VOR and DME as international standard navigation aids at a forthcoming Montreal meeting of ICAO's Navigation Commission and the ICAO Council. Navigation Commission will spend next four weeks studying comments by ICAO members following last year's COM/OPS/RAC meeting in Montreal where VOR and DME won approval. Commission recommendation will go to ICAO Council around mid-March, where 14 of the 21 members must vote for VOR-DME if it is to become an international standard.**



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With its rear loading ramp and unobstructed pay load compartment, this helicopter has the ability to airlift a complete Little John system and crew, laying fire on a target 60 miles away 35 minutes after receipt of orders.

Vertol's advanced YHC-1A and the forthcoming YHC-1B (Chinook), provide battlefield transportation which equals the advanced firepower of MoMAR — Mobile Modern Army.

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SUBSIDIARIES: ALLIED RESEARCH ASSOCIATES, INC., BOSTON, MASS.
CANADIAN VERTOL AIRCRAFT LTD., ARNPRIOR, ONT.

Airline Traffic—Calendar Year, 1959

	Revenue Passengers	Revenue Passenger Miles (000)	Load Factor %	U. S. Mail Ton-Miles	Express Ton-Miles	Freight Ton-Miles	Total Revenue Ton-Miles	% Revenue to Available Ton-Miles
DOMESTIC TRUNK								
American	7,637,156	5,619,363	70.4	22,548,585	10,530,684	100,570,779	673,236,065	60.5
Braniff	2,123,000	941,432	58.2	4,170,922	2,184,276	7,803,167	104,526,057	48.9
Capital	3,871,275	1,612,450	58.4	5,926,523	3,225,399	4,688,695	168,371,912	51.1
Continental	1,107,000	676,978	54.8	1,585,192	833,702	2,605,448	69,926,033	45.3
Delta	3,048,701	1,559,038	57.1	5,031,241	3,576,630	15,266,022	173,850,599	51.6
Eastern	8,199,749	4,445,537	50.77	12,490,127	6,182,785	17,026,033	463,846,782	42.14
National	1,765,450	1,113,451	55.3	3,822,433	880,174	7,055,274	119,588,523	44.9
Northeast	1,239,223	519,047	50.3	1,257,494	471,322	1,352,325	52,875,577	41.2
Northwest	1,817,479	1,393,847	55.7	7,195,045	3,213,432	16,153,102	160,265,535	48.9
Trans World	5,162,914	4,606,442	70.5	17,593,009	8,943,670	32,130,338	499,960,331	61.1
United	7,040,889	4,877,844	66.6	31,281,184	11,977,508	74,102,892	585,655,526	59.9
Western	1,635,819	899,100	60.2	3,596,337	1,081,213	3,846,928	94,662,808	51.9
INTERNATIONAL								
American	114,582	117,665	62.5	122,060	6,150	2,624,662	14,899,553	63.5
Braniff	48,726	91,131	51.2	256,719	.....	1,291,943	11,468,081	47.7
Caribbean Atlantic	334,731	23,292	66.0	22,714	.....	59,855	2,542,534	71.0
Delta	47,651	60,023	48.5	83,499	.....	458,799	7,221,385	42.9
Eastern	417,208	610,200	54.07	1,003,966	.....	1,621,943	65,539,392	51.70
Mackey	121,750	23,859	45.8	.....	2,000	41,897	2,608,723	45.7
National	77,905	55,196	50.4	103,891	61,357	477,813	6,505,114	44.9
Northwest	184,976	356,790	54.0	16,170,366	263,228	11,801,099	66,122,434	61.1
Pan American								
Alaska	51,586	52,707	50.0	412,336	.....	1,813,013	7,906,137	53.2
Atlantic	1,262,199	1,779,389	70.6	16,967,026	.....	34,641,301	238,195,633	63.2
Latin America	1,315,566	1,478,651	68.0	5,046,765	.....	54,411,897	202,782,009	66.7
Pacific	334,113	1,282,911	77.7	17,140,859	.....	24,993,799	176,140,809	70.7
Panagra	131,433	187,653	60.6	846,882	.....	5,855,405	27,132,108	63.1
Resort	159	512	24.3	.....	.....	40,909,055	40,980,776	79.9
Trans Caribbean	94,028	150,752	80.3	.....	.....	3,736,576	15,955,338	77.5
Trans World	347,410	1,066,259	69.5	11,507,926	.....	21,364,936	143,154,605	68.4
United	113,759	282,913	71.4	1,774,706	24,121	1,105,778	31,790,261	69.3
Western	53,459	82,910	64.1	129,188	.....	204,386	9,078,315	66.1
LOCAL SERVICE								
Allegheny	562,040	98,878	47.2	146,573	266,194	338,691	10,190,198	46.4
Bonanza	226,754	55,694	45.1	80,783	29,972	103,708	5,540,599	44.8
Central	165,629	32,324	37.1	92,766	46,987	141,908	3,379,462	33.8
Frontier	306,676	78,304	38.4	288,205	121,848	781,809	8,735,307	44.1
Lake Central	227,182	36,194	41.5	50,173	210,388	.....	3,722,092	45.1
Mohawk	560,260	109,862	54.8	147,715	194,852	199,408	11,021,396	54.9
North Central	911,916	159,835	44.75	416,537	538,495	220,006	16,725,273	45.75
Ozark	539,062	93,860	43.9	166,118	288,339	316,948	9,741,206	46.3
Pacific	468,238	104,878	54.4	174,320	56,276	99,024	10,331,852	52.9
Piedmont	480,913	102,483	45.2	184,524	163,018	192,468	10,361,740	46.0
Southern	255,039	45,583	36.6	125,109	126,720	168,942	4,793,228	37.5
Trans-Texas	283,588	67,218	39.9	227,920	124,810	420,660	7,210,294	41.0
West Coast	343,589	72,021	43.03	99,589	42,087	141,567	7,160,253	44.68
HAWAIIAN								
Aloha	288,385	41,689	60.5	26,497	.....	76,142	3,458,768	56.2
Hawaiian Lines	474,701	88,616	62.8	77,321	.....	1,700,418	9,209,421	61.4
CARGO LINES								
AAXICO*	.....	.....	.....	.....	.....	.....	.....	.....
Aerovias Sud Americana	.....	.....	.....	.....	.....	7,004,967	7,004,967	85.5
Flying Tiger	28,605	127,647	99.2	619,381	838,407	123,600,064	137,822,529	85.4
Riddle								
Domestic	.....	.....	.....	83,178	331,441	30,702,684	31,117,303	74.5
Overseas	.....	.....	.....	22,543	8	7,618,861	7,641,412	71.5
Seaboard & Western	8,418	33,387	100.0	5,523,657	.....	34,795,039	43,736,454	61.8
Slick	33,387	205,828	95.58	.....	.....	30,110,771	50,693,026	97.06
HELICOPTER LINES								
Chicago Helicopter	204,452	3,678	50.7	14,435	.....	.....	364,577	42.4
Los Angeles Airways	43,351	1,487	56.6	54,527	27,416	.....	224,088	63.2
New York Airways	124,199	2,397	50.1	18,095	13,788	7,327	268,295	49.2
ALASKA LINES								
Alaska Airlines	109,543	90,858	58.0	760,362	40,802	3,920,506	13,736,627	56.1
Alaska Coastal	55,168	5,771	57.4	47,232	.....	48,002	683,801	62.5
Cordova	13,592	2,483	39.4	52,026	.....	545,637	853,698	46.5
Ellis	58,799	3,679	57.2	25,848	.....	31,564	430,970	67.0
Northern Consolidated	19,542	6,420	37.7	398,277	.....	661,476	1,762,028	60.1
Pacific Northern	120,713	113,389	49.0	1,369,986	85,236	3,220,603	17,012,783	59.7
Reeve Aleutian	13,528	12,153	37.3	496,068	.....	962,382	2,789,607	59.2
Wein Alaska	41,771	14,063	27.1	483,714	.....	773,544	4,889,511	57.1

* Not available.

Compiled by Aviation Week from airline reports to the Civil Aeronautics Board.

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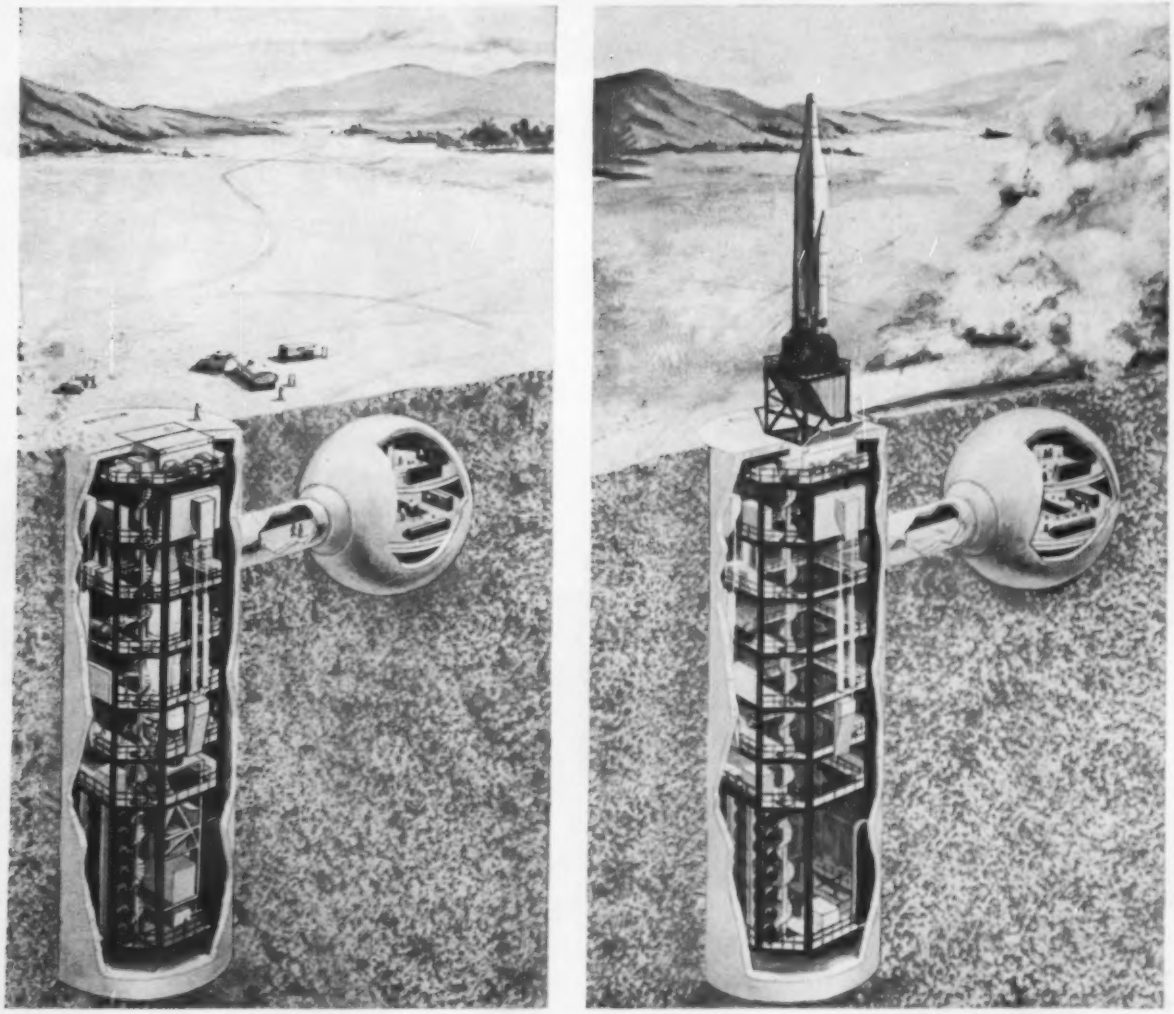

ARTIST'S conception of Atlas underground silos shows checkout, maintenance and fueling operations (left) and the ICBM raised for firing (right). Countdown is conducted in spherical underground control room. Convair is constructing an above-ground mockup.

USAF Plans Six Hardened Atlas Sites

Los Angeles—Hardened, underground silo-type launching sites will be constructed by the Air Force for six of the 13 Convair Atlas intercontinental ballistic missile squadrons now planned.

The Atlas mounted vertically in the newly designed silos can be fired in less than 10 min. after warning of an enemy attack with only a minute or so required above ground for engine start. This compares with a reaction time approaching 20 min. for the Atlas in soft installations where the missile must be raised into an exposed vertical position above ground for propellant loading, final checkout and firing.

Vulnerability of the underground-based Atlas as compared with those in soft sites will be greatly reduced by the silo's heavy concrete and steel construction and by placing the missile in a shock mounted crib to protect it against all ground vibrations that are not strong enough to collapse the silo.

Cryogenic Tanks

The crib will be made of steel girders and isolated from the silo by a network of springs. In addition to the Atlas, the crib will house and protect the cryogenic tanks for storing the liquid oxygen oxidizer and the elevator machinery for raising the missile to ground level. The elevator and liquid oxygen tankage are housed in the lower 65 ft. of the 145-ft.-deep shockproof crib.

Improvement in combat firing time in the silo site will be gained partially through storage of the JP-4 fuel in flight-ready condition in the missile's tanks and partially through the use of American Bosch Arma Corp.'s all-inertial guidance system which is simpler to maintain on a ready basis than the early radio-inertial system. Missile launch under tactical conditions will differ from the research-and-development-type Atlas launch in that the missile will not be held down until the engines reach their peak thrust in an even operation. The missile will lift off the pad as soon as possible to keep the exposure time above ground as short as possible.

Full scale mockup of an underground Atlas launching complex is now being constructed behind the Convair-Astronautics plant at San Diego. The shock-

proof crib has been divided into two parts to facilitate its construction above the ground.

One part will contain the missile housing and servicing section, with several closely spaced work levels to facilitate maintenance. The other part of the crib mockup will allow positive placement of the elevator equipment, liquid oxygen pumps and tankage before actual silo construction is begun.

Firing control center for each Atlas silo will be located in a spherical underground room located a short distance away and connected to it by a tunnel. No antenna system will have to be exposed above ground during the launch and engine burning portion of the Atlas flight from a hardened site.

Construction costs for a squadron of nine of these silos and underground control rooms is estimated at $44 million. The silos will be located a little more than two miles apart, the actual distance depending upon the type of ground in which they are placed. Construction expenditures for a soft-based Atlas squadron averages about $22 million.

In these sites, the missiles will be kept in a horizontal position in buildings that will take very little more overpressure than they would receive in a hurricane.

Semi-hard bases also are programed for the Atlas in which the buildings of the soft sites essentially have been placed below ground or have had large mounds of protective earth placed around them. Both the soft and limp bases have the disadvantage that the missile must be exposed vertically for several minutes prior to launch, and a high wind would be sufficient to topple them over. Construction costs for the semi-hard squadron installation is approximately $29 million.

Site Locations

Six squadron locations for the silo-based Atlas are now planned: Shilling AFB, Salina, Kan.; Lincoln AFB, Lincoln, Neb.; Plattsburg AFB, N. Y.; Dyess AFB, Abilene, Tex.; Altus AFB, Okla., and Walker AFB, Roswell, N. M.

Three squadron locations have been selected for the semi-hard Atlas bases: Fairchild AFB, Spokane, Wash., where construction has begun; Forbes AFB, Topeka, Kan., and Warren AFB, Cheyenne, Wyo. Missiles deployed in these semi-hard sites will have all-inertial guidance systems.

Three soft squadrons are planned—two at Warren AFB and one at Offutt AFB, Omaha, Neb. Construction has begun at all three squadron sites.

One Atlas squadron also is planned for Vandenberg AFB, Calif., where construction has begun on launching installations which resemble the type used during development testing. Each launch pad is serviced by a large gantry crane that raises the missile to an upright position after a warning so that it can be loaded with propellant. After the necessary checkouts, the gantry is moved back for firing.

Under earlier Defense Department plans, nine Atlas squadrons were programed. The four new squadrons added to the program are all in hard sites, and two of the current hard squadrons were converted from semi-hard units.

Estimated construction costs of a hardened Titan squadron installation runs from $43 to $49 million, depending upon whether one control room can service three Titan silos or one in the particular location.

Strategic Air Command squadron tables includes one missile in reserve in addition to the nine in silos.

NAA Designs Rocket Engines for Aircraft

Canoga Park, Calif.—Family of small bipropellant rocket engines designed to boost aircraft performance has been developed by Rocketdyne Division of North American Aviation during a four-year Navy program.

The group consists of four series, AR-1, AR-2, AR-3 and AR-4. All use the aircraft's JP-type fuel and 90% pure hydrogen peroxide as an oxidizer. AR-1 thrust is 5,400 lb.; AR-2 series has throttle control over 50% of its thrust range from 3,000 lb. to 6,000 lb.; AR-3 is rated at 8,000 lb. thrust at 35,000 ft. with throttle control over 37.5% of its thrust range; AR-4 is a 12,000 lb. thrust engine with throttle control over 30% of its thrust range.

AR-1 engine was test flown in Navy's North American FJ-4 at Patuxent River and at NAA's Columbus Division about two years ago (AW Mar. 10, 1958, p. 24).

Preliminary series of flight tests on the AR-2 engine was completed in

Azusa Mk. II System at Cape Canaveral Nears Operational Status

Azusa Mk. II missile tracking facility at Air Force Missile Test Center, Fla., is on the south end of Cape Canaveral. Part of the Azusa (AW Feb. 9, 1959, p. 65) antenna field is shown. The Mk. II system is expected to be operational soon; construction is finished and the facility is being checked out before acceptance. System comprises a field of 10 antennas and support equipment. The Mk. II system is designed to measure missile flight positions up to one-tenth of a foot at distances to hundreds of miles downrange.

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It is being built by Allison in cooperation with General Motors Research and the N. V. Philips Gloeilampenfabrieken of Eindhoven, Holland, who initiated the modern development of this 145-year-old engine.

Currently, Allison researchers, scientists and engineers are working under an Air Force contract to develop this engine for use as an earth satellite power plant. Other potential applications include portable or stand-by power packs.

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Illustrated is a segment of a lightweight, highly efficient solar reflector developed by Allison for use with the Stirling-cycle engine.

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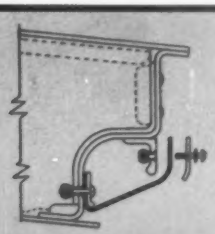
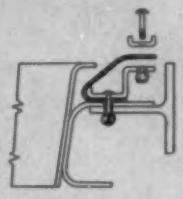


EXTERIOR PASSENGER DOOR INSTALLATION



EMERGENCY EXIT DOOR JAMB INSTALLATION

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March, 1959, with the engine operated at thrusts ranging from 2,000 lb. to 7,000 lb.—1,000 lb. above and below its design specification ratings.

One model of the engine, designated AR-2-3, soon will enter a new flight test phase in an F-86 fighter. The AR-3 is being developed for belly blister installation on F-86 type aircraft, to expand its speed and altitude envelope. Sales targets are the NATO and SEATO nations which now operate large numbers of F-86s. Japan reportedly is interested in the program.

AR-2 series engines draw fuel from plane's regular tanks, and propellants can be pressurized or turbopump-fed to thrust chambers. The turbopump-fed system can supply up to four thrust chambers in a cluster.

Turbopump system for AR-2, which is basic to AR-3 and AR-4 as well, has one centrifugal pump each for fuel and oxidizer, both driven from a common shaft, and one gas generator. Three per cent of oxidizer flow from the pump is diverted through the thrust control valve into a catalyst in the gas generator where it becomes superheated steam to drive the turbine for the two pumps. Pumps, gas generator and other engine auxiliary equipment are mounted around the thrust chamber to keep the installation as small as possible.

Thrust is controlled in pump-fed engines by metering oxidizer flow into the gas generator to control turbopump output and propellant flow rates.

Chamber pressures, which are 560 psia. for AR-1 and AR-2 series, 553 psia. for AR-3 series, and 820 psia. for AR-4s, are sensed and maintained to keep thrust at desired level. Propellant feed systems have fuel from the turbopump outlet passed through a chamber pressure-actuated fuel metering valve, then through the fuel injector into the chamber. Oxidizer is passed through the thrust chamber cooling jacket on the AR-2 engines, and through the tubular walls of AR-3 and AR-4 engines, which need more regenerative cooling at their higher thrust levels. After performing the cooling function, the oxidizer passes through a catalytic screen before entering the thrust chamber injector. The oxidizer enters thrust chamber as an oxygen-rich mixture and superheated steam at 1,365F.

Starting sequence is completely automatic for the engine, and no ignition system is required. Oxidizer, with its oxygen richness and superheated steam, enters the combustion chamber before the fuel, and combustion occurs when the fuel is injected. Shutdown also is automatic if operating limits are exceeded. All engines have air restart capability.

Pilot displays are an oxidizer quantity gage, fuel and oxidizer pressure gage, per cent-of-thrust gage and warning lights.

AMC Contracts

Wright-Patterson AFB, Ohio—Following is a list of unclassified contracts for $25,000 and over as released by the Air Materiel Command.

Westinghouse Electric Corp., Dayton, Ohio, 414 ea., regulators, static type a.c. magnetic amplifier, Aerno 42-0299, maintenance and engineering data for a mobile training unit for F-105 aircraft and installations for C/SC-130 and KC-135 aircraft, (PR EA-0-2925-6129 and amendment No. 1), $327,060.

General Precision Laboratory, Inc., Pleasantville, N. Y., 62 ea., receiver-transmitter radar, RT-528/APN-89A, Aerno 81-8223, used on B-52 aircraft and data and services, (PR E8-0-5841-6433), $93,650.

Bell Helicopter Corp., Fort Worth, Tex., HU-1B helicopters, spare parts, ground support equipment and data, (MIPR R60-11-TCSMC-A), $5 million.

Research, Inc., Hopkins, Minn., cable tension alleviating devices for an aircraft arresting barrier and components to be used in providing retractable cable support for a barrier arresting cable, a retrieving system and control for a hydraulic energy absorber, (PR EM-9-RD-6341), $350,328.

Bendix Products Division, Bendix Aviation Corp., South Bend, Ind., 617 ea., wheel assemblies, main, 26 x 6.6, type VII, in accordance with contractor's part number 512175-1, replenishment spares for F-104 aircraft, (PR 00-0-1630-2440), $90,000.

General Electric Co., West Lynn, Mass., 756 ea., indicators, position, wing flaps, recent markings, type M828023-1, Aerno 60-3173 (installation and spares for use on B-66, C-130, T-33, T-37 and T-38 aircraft), IFB 33-600-60-71 (PR's MA-9-05G-1328 and EA-0-6610-6042 and amendment No. 1), $33,967.

Westinghouse Electric Corp., Dayton, Ohio, 100 ea., generators, AC, 8KVA, P/N 904J206-1, Aerno 42-0335 (for support of T-38A aircraft), (PR ES-0-6115-6217 and amendment No. 1), $314,331.

McDonnell Aircraft Corp., St. Louis, Mo., 62 ea., launch control panels, relay boxes and fire detector units, spare parts for B-52 aircraft (PR SO-0-1510-3028), $200,000.

Ampex Corp., Redwood City, Calif., one ea., magnetic tape recorder, Ampex model FR-114A, series FR-100A tape transport mechanism; one ea., magnetic tape recorder, Ampex model FR-114A, series FR11A tape transport mechanism; two ea., continuous loop magnetic tape recorders, Ampex model FR-102; two ea., synchro footage counters for use with Ampex model FR-114 recorders; one ea., portable tape recorder, Ampex model 1,000.00 601-2P, two channel, 7½ IPS; eight ea., magnetic tape recorder-reproducer (four ea., to reproduce only), Ampex model FR-1107 and acoustical equipment, (PR B/C-003026), $165,778.

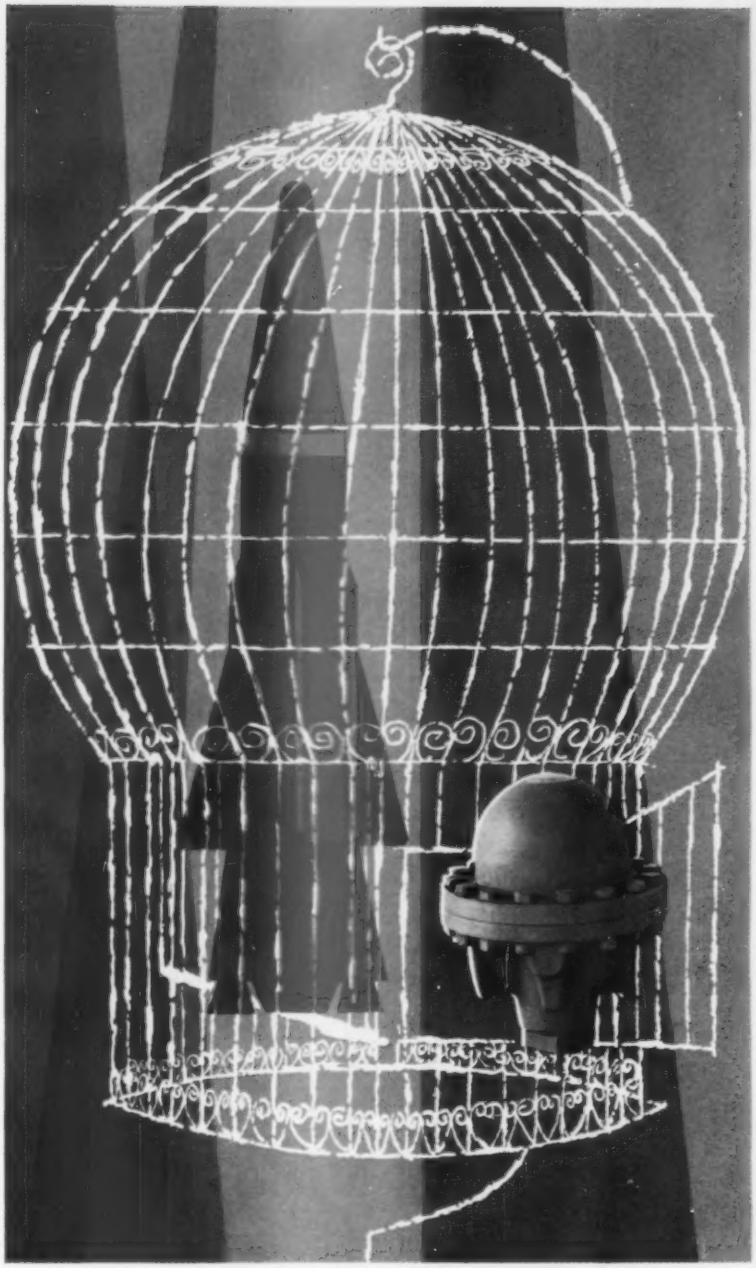
Allegheny-Ludlum Steel Corp., Pittsburgh, Pa., high strength steel sheets, (PR BM-9-MMP-9062 and amendments 1 and 2), $409,-523.

Sundstrand Aviation Division, Sundstrand Corp., Rockford, Ill., 232 ea., transmission and governor assemblies, contractor's part No. 635910G, type MA-3, Aerno 48-0541; 62 ea., automatic paralleling controls, contractor's part No. 621778, type MA-3, Aerno 42-0552; 231 ea., frequency and load controllers, contractor's part No. 637869, Aerno 42-0543, Type MA-3, and spare parts, Use: installations on KC-135A aircraft, (PR EA-0-6150-6034 and amendments 1 and 2 and EA-0-1680-6033 and amendments 1 and 2), $1,181,705.

Giannini Controls Corp., Pasadena, Calif., 131 ea., transmitters, angle of attack, Aerno 60-1603 (installations and depot spares for F-101, F-105, F-106, F-105D and F-106A aircraft), IFB 33-600-60-54 (PR's ES-0-6610-6198 and MC-9-05C-1158), $51,352.

Red Bank Division, Bendix Aviation Corp., Eatontown, N. J., 104 ea., generators, 30 v., 400 amp., d.c., Aerno 42.2364; 83 ea., panels, projection, d.c., type MD-1, Aerno 42-2365 and data (installations for F-105D aircraft), (PR EA-0-2925-6159), $167,393.

Aeronautical Division, Minneapolis-Honeywell Regulator Co., Minneapolis,



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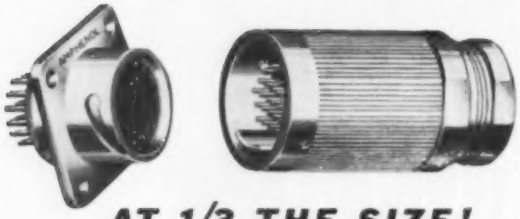

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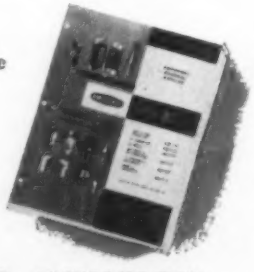

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Minn., six ea., advanced air data indicator systems (six systems with two indicators per system: airspeed Mach number safe speed and an altimeter-vertical speed and terrain clearance indicator), in accordance with WADC exhibit WCLCI-1-81, dated Aug. 18, 1958, reports and data, end use: airborne aircraft accessory, (PR EA-9-ST-4896), $175,783.

Crosley Division, Avco Corp., 149 ea., FSN 1270-567-4320 gyros, integrating, American Bosch Arma Corp., Arma Division, P/N 93580 (applicable to A3A, MD9 and ASG-15 fire control systems (used on B-51 aircraft), (PR WR-9-1270-5180), $153,920.

Bill Jack Scientific Instrument Co., Solana Beach, Calif., test equipment (universal camera control system/simplified camera control system), end use on RF-101 aircraft, (PR MO-9-6760-2131 and amendments 1 and 2; MO-9-6760-2133 and amendments 1 and 2; MO-9-6760-2140 and amendment No. 1; MO-9-6760-2142 and amendments 1 and 2; MO-9-6760-2162 and amendments 1 and 2; MO-9-6760-39219 and amendments 1 and 2), $350,415.

Sperry Phoenix Co. Division, Sperry-Rand Corp., Phoenix, Ariz., components of E-4 autopilot (used on the C-130B aircraft), (PR EG-0-05F-6074), $155,500.

Lycoming Division, Avco Corp., Stratford, Conn., YT55-L-5 shaft turbine aircraft engines, preliminary manuals, spare parts, assemblies and accessories, special tools, ground handling equipment and training for use on U. S. Army VHC-1B helicopters, (PR's 57169, 62427 and 96753), $1,608,000.

Westinghouse Electric Corp., Dayton, Ohio, 47 ea., power supply, 200 amperes, 28 v., Aerno 42-0836 for use as installation and spares for C-130B aircraft, (PR's ES-0-6160-6436 and EA-0-03C-6054 and amendment No. 1), $61,100.

Simmon Brothers, Inc., Long Island City, N. Y., 37 ea., printer, projection, vertical, manual, auto-focus, type EB-52a, stock number EH-6740-597-2684-J360, use as ground support equipment, IFB 33-600-60-41 (MIPR's R59/710/383NSF and R59/730/383NSF), $26,699.

Hughes Aircraft Co., Culver City, Calif., operational test and evaluation of AN/URC-15(V), (PR 47903), $98,461.

Westinghouse Electric Corp., Dayton, Ohio, 213 ea., control panels, Westinghouse P/N 906D057-2, Aerno 42-0326, FSN 4246-6110-606-7875 and data (spares support for B-52 aircraft), (PR SA-0-03C-10400), $185,-500.

Apparatus Division, Texas Instruments, Inc., Dallas, Tex., 18 ea., hydraulic-electrical and yaw stabilization system, running spares, spare parts and data, for AN/APQ-86(XH-1), radar set, end use on L-23 aircraft, (MIPR R02-990098-SC-01-23 and amendments 3, 4 and 5), $244,640.

Semiconductor Division, Hoffman Electronics Corp., El Monte, Calif., silicon solar cell program, (PR BM-0-MMP-9002), $93,-250.

Lycoming Division, Avco Corp., Stratford, Conn., preproduction effort required to establish the capacity and capability to produce the Model T53-L-5 engine in accordance with contractor's engine model specification No. 104.16A, dated May 15, 1959, (for U. S. Army HU-1B helicopter), (PR 47916(MIPR R59-14-TC-RE)), $108,000.

Eclipse-Pioneer Division, Bendix Aviation Corp., Teterboro, N. J., 68 ea., control assemblies, attitude gyroscope, Type A24G-5 in accordance with specification MIL-C-27205, Aerno 60-1514, contractor type 19003-1-A and data (USAF installation in T-38A aircraft), (PR ES-0-6615-6244), $311,596.

Montrose Division, Bendix Aviation Corp., South Montrose, Pa., 766 ea., transmitters, pressure, hydraulic, high temperature, type MJ-1, Aerno 61-2358, spare parts, special tools, test equipment and data, for use on B-52G, F-101, F-105 and T-38 aircraft), IFB 33-600-60-48 (PR's EA-9-6620-4893 and EA-0-6685-6066), $66,376.

Defense Electronics Division, General Electric Co., Johnson City, N. Y., components of the AF/A42G-8 automatic flight control system, for: F-105G aircraft, (PR ES-O-6615-6182 and amendment No. 1), $1,-200,000.

Pioneer-Central Division, Bendix Aviation Corp., Davenport, Iowa, 2 ea., oxygen sys-

tems, closed circuit, respiratory, (1 ea., type I, in accordance with exhibit WCLDEE 59-27; 1 ea., type II, in accordance with exhibit WCLDEE 59-28; 1 ea., type III, in accordance with exhibit WCLDEE 59-29, all dated Nov. 25, 1959), data and reports, end use: airborne aircraft accessory, (PR EA-9-ST-4823), $29,085.

Pioneer-Central Division, Bendix Aviation Corp., Davenport, Iowa, 86 ea., altimeters, pressure, 1⅞ in. dial, type AAU-2/A, Aerno 60-6301 and data, for: F-105D, F-106A and F-106B aircraft, (PRs EA-9-05C-6610-6045 and amendment No. 1 and SA-9-6610-11296), $41,518.

John Oster Manufacturing Co., Racine, Wis., 656 ea., indicators, BDHI, in accordance with contractor's P/N 9813-02, Aerno 81-4457; 70 ea., mountings, in accordance with contractor's P/N C-97420, Aerno 81-4456; 63 ea., coupling units, in accordance with contractor's P/N 9616-18, Aerno 81-4458, spare parts, ground support equipment and data, for use with Tacan, ARN-21, end use: B-52G and various Navy aircraft, (PR ES-0-5826-6164 and amendment No. 1, MIPR R60-3662-39-NOas), $651,770.

Norair Division, Northrop Corp., Hawthorne, Calif., quartz lamp brazing program, (PR BM-9-MMP-9119-1), $200,000.

Bendix Products Division, Bendix Aviation Corp., South Bend, Ind., 1,542 ea., wheel assemblies, main landing gear, 30x8.8, type VII, contractor's P/N 150720-1, USAF S/N 4103-1630-612-3401, Aerno 41-1688, replenishment spares for F-100A and C aircraft, (PR 00-9-1630-2809 and amendment No. 1), $240,072.

Genesco, Inc., Los Angeles, Calif., 175 ea., accelerometers, normal, type MB-3 automatic pilot, contractor's model DDL345 (Minneapolis Honeywell Regulator Co., P/N GG47A-1), FSN/2201-6615-561-4427; 130 ea., accelerometer assemblies, lateral, type MB-3 automatic pilot, contractor's model DDL355 (Minneapolis Honeywell Regulator Co., P/N GG47B-1), FSN/2201-6615-564-9145, for MB-3 automatic flight control system in F-100 aircraft, (PR MA-9-05F-1058), $67,065.

Bell Aircraft Corp., Buffalo, N. Y., double wall structure program, (PR BM-9-MMP-9181), $400,000.

Industrial Electronics Division, General Electric Co., Lynchburg, Va., engineering services for design, fabrication, test and delivery of control monitor group AN/URA-22 and canned message equipment, spare parts, handbooks, data, drawings and reports, end use: unknown, (PR EC-9-16A-4880), $590,657.

Lear, Inc., Grand Rapids, Mich., 110 ea., amplifiers, power supply, Aerno 60-6317; 160 ea., adapter compass, Aerno 60-6319; 161 ea., gyroscope assembly displacement, Aerno 60-6316; 161 ea., controller compass, Aerno 60-6318; 137 ea., controllers, third gimbal, Aerno 60-6320; spare parts, special tools, test equipment and data (components of control assembly, attitude gyro, type AF/A24G-1), end use: F-105D and F-106B aircraft installation, (PRs EA-9-05C-4899; EA-9-05C-4730; EA-9-05C-4731; SA-9-6610-11296; EA-0-05F-6615-6021; EA-0-05F-6615-6015; EA-0-05F-6615-6016; EA-0-05F-6615-6022; EA-0-05F-6615-6024), $984,986.

United States Gauge Division, American Machine & Metals, Inc., Sellersville, Pa., 991 ea., transmitters, pressure oil, engine mtd., 0-100 p.s.i., type MH-5, contractor's P/N ST504G, FSN 6143-6620-602-2074, Aerno 61-2479, use: installation and spares for F-105D, F-104, F-106A, B-52G, C-130B, T-38A and T-39 aircraft, (PRs ES-0-6620-6245 and amendment No. 1 and MO-0-05D-366), $181,353.

Graphic Films Corp., Hollywood, Calif., production of one 35 mm. Eastman color negative motion picture entitled "Space Orbits," P19294, and "Space Communications," P19297, RFP 33-600-60-5024, (PR EM-0-MP-6445), $69,491.

Collins Radio Co., Cedar Rapids, Iowa, product improvement of radar set AN/ARC-58, end use: service test, (PR EC-9-16A-4781), $292,302.

General Electric Co., West Lynn, Mass., 106 ea., indicators, electrical tachometer, turbo, type ERU-5/A, Aerno 61-1200, aircraft: modify the F-106A/B test aircraft, (PRs SA-9-6620-11297 and EA-0-6610-6126), $36,857.

BOMARC pressure system components include RMC-Lindsay Gauges

The Boeing Bomarc, a true "push-button weapon," automatically seeks out and destroys its target. In such a weapon there can be no compromise in the performance requirements for its mechanical and electronic components.

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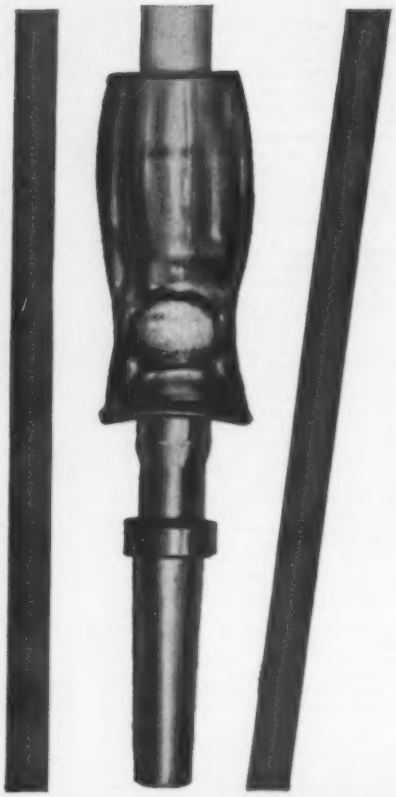
RMC
LINDSAY PRESSURE GAUGES

AMP taper technique points the way to greater reliability



Magnetic Amplifiers, Inc. of New York carefully manufactures its Static Inverters with a step-by-step quality control and testing program to build in the reliability required for aircraft and missile applications.

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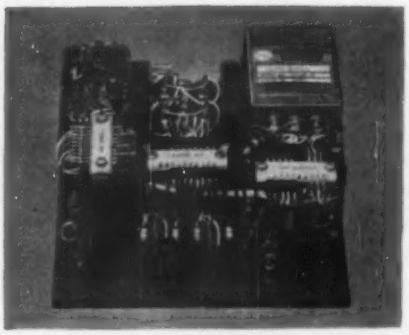
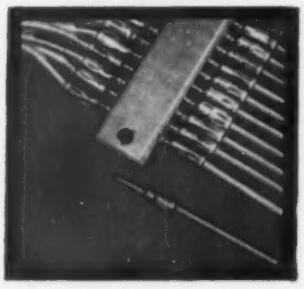


Magnetic Amplifiers' 250VA Static Inverter Model SIS-425041



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Ultraviolet May Have Space Signal Value

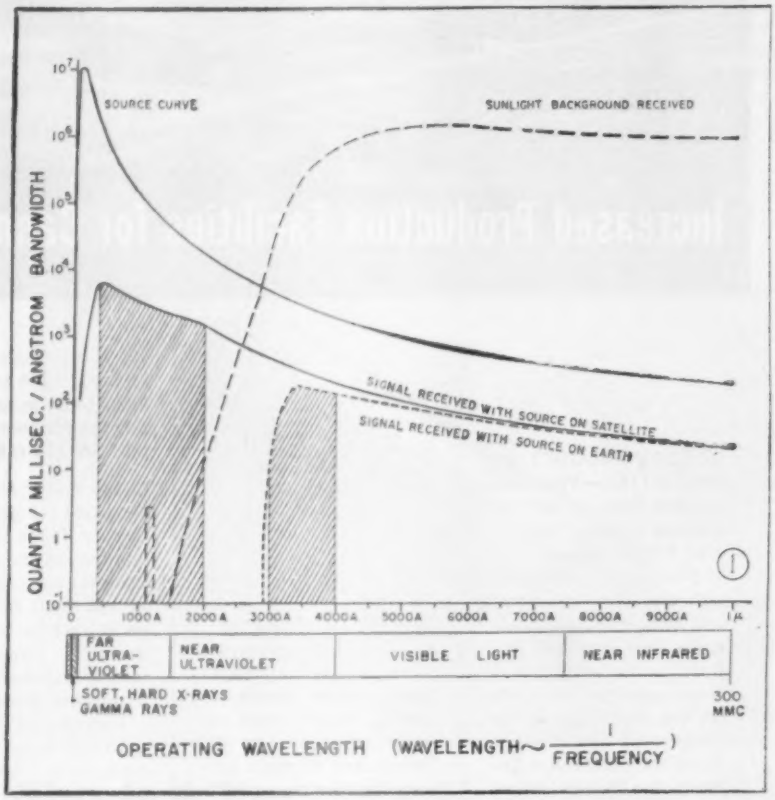
By Barry Miller

Pleasantville, N. Y.—Ultraviolet waves show considerable value for signaling between the earth—or an earth satellite—and space vehicles at planetary distances, according to Dr. Cecil B. Ellis, a senior scientist on the staff of the GPL Division of General Precision, Inc.

Ellis has been studying the communications potential in optical wavelengths below one micron in the near infrared for the past 18 months. After extensive calculations, he concludes that the 400 to 2,000 angstrom section in the ultraviolet band is the best optical region for communication with existing equipment between earth satellites and space vehicles near Mars.

Similarly, he says, 3,000 to 4,000 angstroms would prove an optimum selection if the transmitting sources were located on earth rather than in an earth satellite.

General Precision is one of a growing list of firms becoming interested in the feasibility of space communications or space radar throughout the optical region (AW Dec. 14, p. 87). That list comprises an array of companies with optical, infrared and avionic capabilities. It includes, besides General Precision, Technical Research Group, Inc.; Raytheon Co.; Farrand Optical Co., Inc.; Electro-Optical Systems, Inc.; Servo Corp.; Sperry Gyroscope Co.; Elcon Laboratory, and Arma Division of American-Bosch Arma Corp., all backed up by other groups working on related devices and phenomena.



SHADED PORTIONS under signal received curves indicate most desirable wavelength or frequency selection for optical communications with space vehicles near Mars at its extreme distance from the earth. Exploded wire sources were used in calculations. Abscissa is dimensioned in angstroms and each wavelength is associated with approximate position in optical spectrum.

Government Support

Government agencies are supporting some work; other contracts are in the offing. One firm, Electro-Optical Systems, has a $467,234 contract from Wright Air Development Division for an experimental communication system using deflected sunlight directly without conversion to electrical energy and making it the information carrier by direct modulation.

Most of the work in optical frequencies at GPL and elsewhere, however, is highly theoretical or exploratory. While different portions of what is broadly referred to as the optical spectrum—all the way from the near infrared down to the hard X-ray and gamma ray regions—may appear promising, only further study and experimental work will reveal what their ultimate value will be.

This much seems clear, however, from studies like Ellis'. Optical communications offer valuable and distinct advantages – secure, jam-free long-distance transmission for military use and an extension for space duties of the usable portion of an already overcrowded spectrum.

Currently, GPL is seeking Air Force funding to sustain Ellis' studies in the optical region; but the company, believing optical beams may be valuable in navigation, control and guidance as well as communications, will continue to underwrite this work in the absence of government backing.

Design Problem

Ellis considered the optical spectrum from one micron in the near infrared (or 300 mmc. in frequency) through the visible, near ultraviolet, far ultraviolet, soft and hard X-ray and gamma ray regions. He studied the over-all parameters for a system with transmitter on earth, or an earth satellite, and the receiver in a space vehicle near Mars when the planet is at the far side of its orbit—a distance in excess of 230 million miles.

Receiving System

For the receiving system, he estimates that the space vehicle can carry a 20-ft. diameter collector mirror which would feed the collected radiation into a photomultiplier cell, or a photoconductor, the former for ultraviolet or visible radiation, the latter for infrared. If X-ray radiation was used, a scintillation counter could be the detector. Outputs from these devices can be amplified and then fed to the readout devices.

On the sending end, a parabolic mirror with a light source at its focus would be selected to maximize the amount of light focused into the receiving collector. In Ellis' calculations, a transmitter mirror with a focal length

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of 25 ft. and a diameter of 30 ft. was assumed.

Unless the mirror surface material is properly selected, some useful signal will be lost due to a drop-off in mirror surface reflectance in the far ultraviolet region. At 10,000 angstroms (or one micron) aluminum is 95% reflective and slightly less reflective at 2,000 angstroms, near the edge of the far ultraviolet region. In the far ultraviolet, germanium, another possible mirror material, is estimated to be only 48% reflective, a figure which drops to 20% at 400 angstroms. In fact, Ellis says, this fall-off in reflectance is the basic limitation on the earth-satellite-based system at the shorter wavelengths.

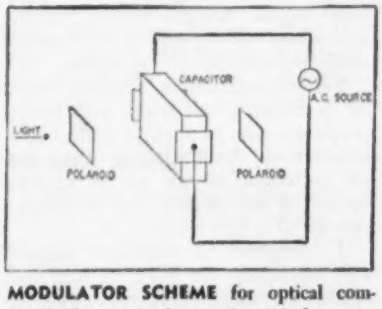
Besides choosing large mirrors, the designer can increase signal strength by boosting the light output. One method of producing a bright source, and the one selected by Ellis for his study, is to pass high currents through fine wires, thereby producing high temperatures and high intensity sources. With this exploded wire technique, a 350,000K temperature probably can be made to persist for one millisecond although its exact spectrum is unknown. The spectrum of a 22,000K exploded wire, however, can be made to approximate that of a black body.

Timed Flashes

With the exploded wire technique, a practical system can be designed to mechanically connect sections of fine wire to a circuit periodically, thus producing timed, perhaps coded, flashes at the transmitter focus. In his calculations, Ellis assumed one millisecond light flashes could be obtained from a 350,000K source. Other possible sources, such as high intensity arcs, gas discharges, the projected optical Maser and the sun itself might be used but were not included in this survey.

Signal and background variables for optical communications to a spaceship near Mars' orbit were calculated and plotted in the graph on p. 63 using the previously mentioned assumptions. Separate parts of the graph are as follows:

- **Signal strength** or source curve, which indicates the output of a spherical black body source of the diameter expected to be useful with a 30-ft. transmitter mirror. From right to left, this curve rises to a maximum near 80 angstroms, falls abruptly in the soft X-ray region. It indicates the maximum signal source is available at short wavelengths approaching the 80 angstrom limit.
- **Signal received** with source on satellite curve, calculated with the source curve and including the assumptions on mirror reflectance and the dimensions of the transmitter mirror. The drop-off in the far ultraviolet is due to the poorer reflectance at the very short wavelengths.
- **Signal received with source** on earth curve, which includes the necessary correction for attenuation of optical waves by the earth's atmosphere. Atmospheric transmission varies from 96% at one micron in the near infrared, to approximately 43% in the visible region at 3,400 angstroms and drops to zero at 2,900 angstroms in the near ultraviolet.
- **Sunlight background** received curve, which represents the reflected sunlight from the earth, its clouds and its oceans



MODULATOR SCHEME for optical communications uses changes in optical properties of capacitor dielectric under influence of electric field to control light passage through polaroids.

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ENGINEERING
REPORT
ON BENDIX COMPONENTS

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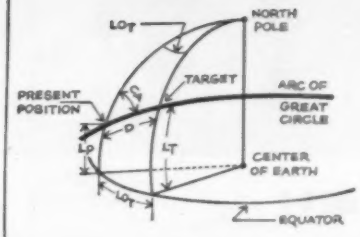
TYPICAL PROBLEM



PROBLEM: Design a computer to provide an aircraft with continuous bearing and range information along the arc of a great circle.

C_A—Bearing

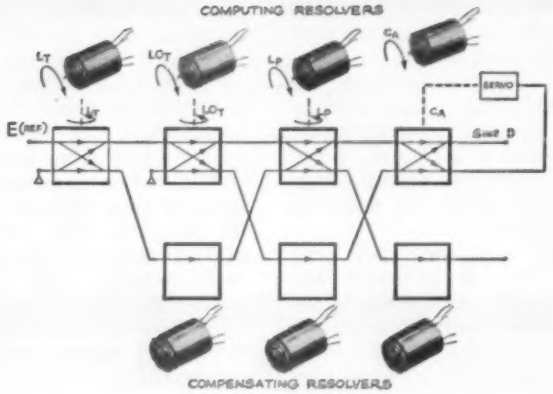
LO_T—△Longitude measured from present position to target

L_P—Latitude of present position

L_T—Latitude of target

D—Great Circle distance from present position to target.

SOLUTION



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seen by a receiver collector mirror from its position near Mars.

The product of these curves and photocathode efficiency is an indication of the received signal; the noise level is the square root of the number of emitted photoelectrons originating with the background noise curve.

Signal-to-noise ratios were computed and the highest found to be in the 2,000 to 400 angstrom region. These ratios are sufficient for sending a signal at one bit per flash far beyond Mars. Alternately, if this added transmission distance was not needed, the source temperature for this problem could be reduced.

When the source is on earth, however, the signal-to-noise ratio is greatest in the 4,000 to 3,000 angstrom region but is insufficient to permit communication with Mars when the planet is at the far side of its orbit. This distance could be gapped, Ellis says, under these conditions if the photomultiplier electrical signal were permitted to accumulate several flashes for this distance at a sacrifice in the information rate.

The signal-to-noise ratio for a single flash from the earth transmitter is sufficient, however, for communicating with Mars on its closest pass to earth, a distance of roughly 36 million miles. Communication to the moon would be correspondingly easier, allowing an appreciable decrease in source temperature.

X-Ray Regions

Soft and hard X-ray and gamma ray regions were examined and found to be unsatisfactory for this application because of unfavorable signal-to-noise ratios. Signaling is possible by enlarging the signal collection time to several seconds or minutes per bit, but this would make power requirements prohibitive.

Ellis cautions that his calculations are based on equipment known to be available. New components, such as optical Masers which are now being built, could alter the desirability of using the wavelengths in the ultraviolet region. Optical Masers, initially at any rate, are not expected to operate much beyond the visible region.

Various modulation schemes, based on mechanical, electrical and optical properties, may be used in optical communications. An illustration of one simple technique is the use of rotating blades of an electric fan to control passage of a light beam.

To modulate at megacycle frequencies, according to Ellis, a Kerr cell might be used effectively. This requires two parallel-placed polaroids with axes crossed to block light passage. A container of a liquid such as nitrobenzene sandwiched between par-

X-Ray Space Communications Studied

Waltham, Mass.—X-rays and high-energy particles will be investigated here as possible means of space communications by Tracerlab, Inc., under a $73,663 contract from the Rome Air Development Center.

The company will study the feasibility of generating, modulating and detecting X-rays and high-energy particles for a communication system which would operate beyond the earth's atmosphere where absorption losses are expected to be negligible.

Intelligence may be conveyed by X-rays or charged particles, such as electrons, at reasonable speeds across significant distances in space, the company's proposal to the Air Force points out. Power requirements for an electron system, the proposal reasons, ought to be comparable to those of a radio system, and perhaps a factor of 100 to 1,000 times less than those of the X-ray system. Size and weight of generators and detectors of either system should not differ appreciably from those of radio equipment.

A severe limitation to the use of X-rays, however, is their inability to be focused; consequently, X-ray intensity diminishes with the square of the distance from the source. X-rays may be generated by electron bombardment of a target material or by a radioactive source, but the conversion of electron energy into X-ray energy tends to be inefficient.

Accelerated electrons themselves might be used for communications at a considerable power saving because a beam can be electrostatically focused into a restricted solid-angle, the company's proposal indicates. Conversion efficiencies of 50% are possible. The electron system has one serious disadvantage—it is susceptible to disturbance by electric or magnetic fields.

As in other exotic communication techniques, modulation methods are a key factor. Counterparts of standard radio modulation, however, may be found in an high-energy particle system. AM and FM modulation would become, respectively, variations in particle flux intensity and energy modulation in an electron system. The former method might be less reliable because quantum statistics enter into calculations of signal reception. An analogy with phase modulation could involve transmission of unique sequences of energy bursts, statistically unlike the cosmic background. More complicated methods of superimposed patterns of amplitude and energy are also possible, according to Tracerlab.

Some of the restrictions that terrestrial operation places on X-ray equipment would be more relaxed in space. This can be illustrated by a broadcasting system earth satellite. It might consist of a lightweight, metallized balloon which would be inflated to a low pressure at the proper altitude. A filament located at the center of the balloon would provide a source of electrons which would be accelerated to the balloon surface. Its operation would be similar to a conventional gas-filled X-ray tube. Because the input power would be dissipated over a large area, heat loss would be sufficiently rapid to allow generation 1,000 times the generation possible with a terrestrial X-ray tube, Tracerlab says.

Detectors for X-rays and electrons could be ionization chambers which might be made very large in space. A light aluminized balloon, perhaps 100 ft. in diameter, might be used.

Final evaluation of these systems would consider the weight, bulk, power requirements, lifetime, reliability, jammability, reception exclusiveness and other factors. These would be compared with those of communication systems based on radio and light waves.

allel plates to form a capacitor can be inserted between the polaroids.

When a generator applies an alternating field across the capacitor, the optical properties of the liquid change, thus altering the plane of polarization and permitting light passage at prescribed intervals.

Magnetic Analog

A magnetic analog of the Kerr effect, in this case involving the faraday effect, would replace the capacitor with an yttrium iron garnet in a magnetic field. An investigation of the faraday effect in garnet crystals now is in progress at GPL.

Other modulating techniques including applications of the Pockels, Cotton-Mouton, Voight, and photoelastic effects might be possible, Ellis notes.

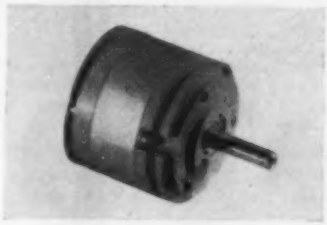
Sources throughout the optical range differ markedly. From one micron on, light can be generated by applying d.c. electric power to a rugged tube, or low-frequency a.c. can be applied through a transformer to a source tube. X-rays could be emitted through electron bombardment.

In the gamma ray region, radiation is generated by disintegration of atomic nuclei. For shorter ranges, Ellis points out, the source could consist of a small mass of lead-shielded radioactive material which could emit radiation when a shutter is opened in the shielding. More intense sources can be obtained

ENGINEERING
REPORT
ON OTHER BENDIX
COMPONENT PACKAGES

GEAR HEADS

Compact units that provide output motor speed reductions.



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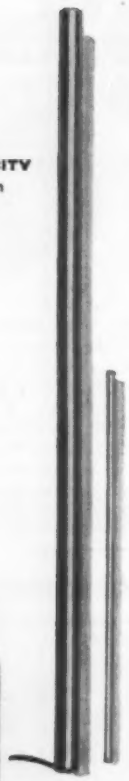
DISPLACEMENT
Models 580 (top) and 581 (bottom)



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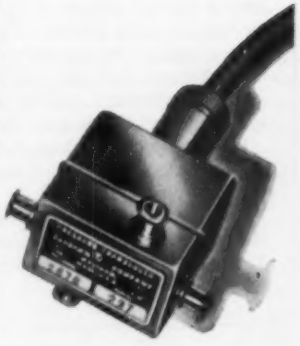

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from a nuclear reactor, which might consist of two pieces of fissionable materials separated by a periodically varied distance to produce gamma ray bursts for communications.

There are, according to Ellis, many types of components and physical phenomena which should be explored in further investigations of optical communications.

These include:

• **Detectors**—Photomultipliers responsive into the far ultraviolet and the soft X-ray region, detectors employing fluorescent and thermoluminescent phenomena, the use of scintillation counters in the far ultraviolet, X-ray and gamma ray regions, and possible use of cryogenic temperatures for special optical-mechanical transducers should all be examined.

• **Polarization effects**—These may be utilized in discriminating against reflected light. Polarization compensators and other optical techniques ought to be studied.

• **Filters**—Special emphasis should be placed on filters for narrow frequency use; interference filters and the optical Maser should receive careful thought.

• **Mirrors**—Because mirrors may be used widely in optical systems, the aberration properties of paraboloidal and other aspheric mirror systems need to be studied for proper design selection. New mirror types should be sought.

• **Information rates**—To conserve power and work at low S/N ratios, the best methods of transmitting information over an optical channel should be explored by information theory techniques. Frequency shifting in RF as compared with optical waves should be compared.

• **Particle beams**—The feasibility of using beams of material particles for signaling in outer space ought to be studied. A small nuclear reactor on a spaceship could flash periodically to send pulses of neutrons with coded information. Similarly, positron beams might be generated from radioactive isotopes.

• **Underwater**—Although optical waves are attenuated severely underwater, they offer possible secure underwater communications for which closely spaced repeaters would be necessary.

AIRBORNE scanner assembly is checked out at Fairchild Camera & Instrument Corp.

Fairchild Air-Ground Photo System Set for Flight Transmission Tests

Syosset, N. Y.—An air-to-ground photo-transmission system for in-flight relaying of reconnaissance photographs from a drone or manned aircraft to ground viewing stations is about to undergo flight testing here.

The system will enable a ground observer to view reconstituted photographs within minutes of the snap of an airborne camera's shutter. Fairchild Camera & Instrument Corp. is responsible for developing the system under a triservice award from the Army Electronic Proving Ground, Ft. Huachuca, Ariz.

Aerial Photograph

With this system, a high-resolution aerial photograph can be taken, processed and then scanned by a small flying light spot scanner whose output is converted to electrical pulses which are transmitted to the ground. At the

Simplified built-in pump elements save space, weight, costs

It's no longer necessary to buy complete pumps for handling fluids at pressures up to 1,000 psi. Now . . . for a fraction of the cost . . . you can design three simple components integrally into your mechanisms and get equal or better performance.

Fig. 1. Three Gerotor components permit pump to be incorporated as integral part of housing or frame of mechanism, eliminate need for purchase and mounting of separate, complete pump.

Three matched components are all you need buy. *(Fig. 1.)* Consisting of an inner and outer Gerotor and an eccentric locator-ring, the unit becomes a complete pump by simply boring the casting or frame of the mechanism to accommodate the eccentric ring O.D. and by providing porting. This design makes the main casting do double duty as the pump housing, thus eliminating a very considerable cost factor. A drive can be taken from any convenient shaft.

Gerotor Insert-Packages can be designed and mass-produced to deliver up to 100 gpm and 1,000 psi within a wide range of mechanism geometry. That's because Gerotor pump capacity is a function of diameter, thickness, number of teeth and rpm of the two moving parts. These variables can be matched to just about any space restriction and capacity requirement.

Your built-in pump will give you all the advantages that make Nichols positive-displacement Gerotor pumps first choice for numerous applications: It is lightweight, valveless, self-priming, long-wearing, balanced and extremely quiet. In addition, it has high mechanical and volumetric efficiency. *(Fig. 2.)*

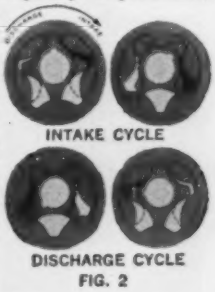


FIG. 2

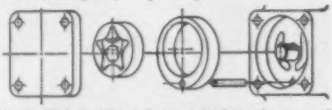
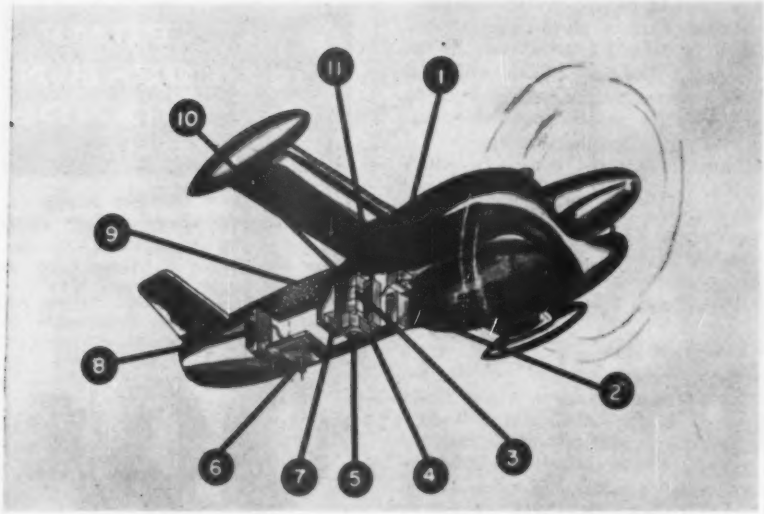


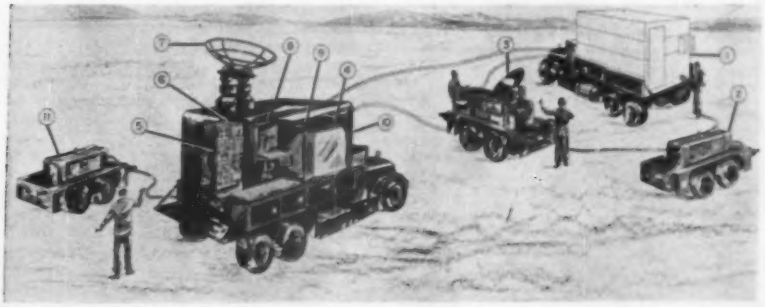
Fig. 3. Nichols integral pump-package is as easily installed as an anti-friction bearing.

Investigate this concept of integral pump design. Our technical assistance is on call at all times to show you how to build these low-cost packages into your equipment. *(Fig. 3.)* Write:

W. H. NICHOLS CO.
Woerd Ave., Waltham 54, Mass.



AIRBORNE portion of photo-transmission system is shown in artist's concept. Components are control box (1), junction box (2), magazine (3), camera body (4), lens cone (5), stub antenna (6), scanner (7), transmitter (8), flash cartridge ejector (9), processor (10) and slack box (11).



GROUND EQUIPMENT for photo-transmission system consists of radar shelter (1), power units (2 and 11), AN/GPG-1 tracking radar (3), plotting board (4), receiver and signal generator rack (5), monitor and antenna control rack (6), receiving antenna (7), ground camera-processor-viewer (8), air conditioner (9), and equipment shelter (10).

GROUND SUPPORT equipment for photo-transmission system being checked by engineers includes (from center to right) cathode ray tube display camera reproduction rack, direct view monitor and receiving antenna control rack, and the receiver and power supply rack.

CBS Photo Recon

Stamford, Conn.—First units of a high-resolution aerial photo reconnaissance system developed by CBS Laboratories here have been delivered to an undisclosed military agency, according to a company spokesman.

The system can scan visual images obtained by an aerial camera and convert them into signals for transmission from an airborne vehicle to airborne relay or ground receiving stations where the pictures can be reconstituted. Total time from aerial photographing to reproduction of film on the ground can be as little as 30 sec., CBS says.

Key element in the system is what is described as a unique CRT, known as a Line Scan Tube.

ground station, the telemetered signals are reconstituted on a cathode ray tube to provide a rough picture. Higher resolution pictures (20 lines/mm. on 70 mm. film) are produced by a ground recorder.

Airborne portion of the system, including the telemetry transmitter, antenna, two-stage processor, modified KA-26 camera, scanner and controls will weigh about 120 lb. The camera-processor-scanner equipment alone occupies 1,500 cu. in., weighs 45 lb.

The KA-26 is equipped with four interchangeable lens cones with lens focal lengths of 1.5, 3, 6 and 12 in., all better than f:4.5. The lens is preselected before vehicle takeoff.

Transmission bandwidth of this system is 1.5 mc. with transmission on 2.25 kmc. Future versions of this system which are now being negotiated for procurement will use the newly allocated 4.4 kmc. to 5 kmc. area and have 4.5 to 6 mc. bandwidths, according to Fairchild.

The camera will be outfitted with flash cartridges for night operation. Future systems of this type are expected to handle infrared or radar photos.

FILTER CENTER

▶ **Radio Ducts Confirmed**—Existence of a 500-ft.-thick radio duct, produced by trade wind temperature inversion, at a height of 5,000 ft. extending from West Africa to the coast of Brazil, which permits propagation of VHF frequencies far beyond line-of-sight distances, has been confirmed by recent Naval Research Laboratory tests (AW Nov. 9, 1959, p. 23). Using frequency of 229 mc. and a transmitter power of only 100 watts, signals were detected by Navy aircraft at distances of nearly 1,500 mi. at the duct altitude. Measurements confirmed predictions based

on meteoroiogical studies made by Naval Research Laboratory, Air Force Cambridge Research Center and Electromagnetic Research Corp. Scientists predict that the radio duct should provide a stable transmission medium throughout the year with only a small seasonal variation in height. Similar radio ducts are predicted for other trade wind areas: North Atlantic and North and South Pacific. Future programs will investigate radio ducts between California and Hawaii, experienced by Pan American World Airways in its VHF ground-air tropospheric scatter tests (AW Jan. 18, p. 46), as well as methods for coupling radio energy into and out of the elevated duct from ground-based transmitters and receivers.

▶ **Engineer Enrollment Down**—Despite continuing demand for engineers, freshman engineering enrollment in 1959 was 3% below 1958 which in turn was down 11% from the previous year, according to the Federal Office of Education.

▶ **Esaki to Join IBM**—Dr. Leo Esaki, Japanese scientist who discovered the tunnel diode, will join International Business Machines Corp. as a resident consultant in the company's semiconductor research department at Poughkeepsie, N. Y. The tunnel, or Esaki, diode is expected to find widespread use in digital computer circuits.

▶ **USAF Seeks Dendritic Transistors**—Westinghouse Electric will develop processes and equipment for quantity production of dendritically grown single crystal semiconductor materials, under new Air Materiel Command contract. USAF seeks to apply novel technique to fabrication of low-cost, reliable semiconductor devices as well as to its USAF-sponsored molectronics program (AW Feb. 8, p. 79). Using newly developed dendritic growing process, company can produce semiconductor crystal in the form of thin, narrow, highly polished ribbon, eliminating many of the costly operations now required to convert a crystal into an end semiconductor device. Under AMC contract, Westinghouse will use silicon and gallium arsenide materials. Company has recently developed technique for growing a complete semiconductor "sandwich," including two junctions, by the dendritic process.

▶ **Tips for Designers**—Application Notes For Military Receiving Tubes, a supplement to "Military Handbook No. 211, Techniques for Application of Electron Tubes in Military Equipment," which goes beyond the handbook in dealing with various application problems commonly encountered in complex equipments, has been prepared

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Long experience in the fabrication of assemblies from heat resistant metals, such as ... molybdenum, tantalum, tungsten and columbium ... enables California General to maintain the difficult schedules which today's Missile Industry demands ... California General boasts more than experience. A large stockpile of refractory metals ... imagination and technical skills ... make it possible for California General to fabricate and deliver space-age assemblies* to the customer with the greatest speed and exactitude.

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Tests at Allied Chemical show Nitrogen Tetroxide ready for instant use even after 9 years of storage. Combustion tests with important liquid fuels and Nitrogen Tetroxide indicated up to 99% theoretical combustion efficiency. Additional advantages offered by N_2O_4 are listed at right.

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- **Requires no refrigeration** — can be stored indefinitely in missile at launching site.
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- **Eliminates rough starts**—which are due to accumulation of unreacted propellants in thrust chamber.
- **Motors are throttleable**—when N_2O_4 is used as the oxidizer.
- **Immediate availability**—Allied Chemical Nitrogen Tetroxide is shipped in 125- and 150-lb. steel cylinders, 1-ton containers, 30- and 50-ton tank cars.

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2819

by Arinc Research Corp., Washington, D. C., under a joint service contract. New handbook, identified as Publication No. 101-17-145, covers long-life assurance of electron tubes, tube characteristic spreads and cathode bias, screen-grid voltage-dropping resistors, series operation of heater strings, warm-up and operation time, heater-cathode leakage, parallel operation of electron tubes and application data on 20 tube types covered in MIL-STD-200D. Copies are available from Arinc Research Corp., 1700 "K" St. N.W., Washington 6, D. C. at $2.50 each.

▶ **SAGE Radars for Traffic Control**—Two of 12 Sperry-developed AN/FPS 35 SAGE radars are expected to be tied into FAA air traffic control system.

▶ **Flat Plate Satellites**—Passive communication system employing circular, flat plate reflectors in synchronous orbit around the earth is being studied by Air Force Cambridge Research Center. Flat reflectors provide signal directivity not obtained with far larger spherical reflectors of the type to be used in forthcoming satellite experiments.

▶ **Scope Patterns Recorded**—Laboratory prototype of a device which records oscilloscope patterns on ordinary paper rather than on film and whose response time is determined by the oscilloscope is expected to be operated within a month at Elcon Laboratory, Inc., 238 Main St., Cambridge, Mass. The process is electronic, not photographic.

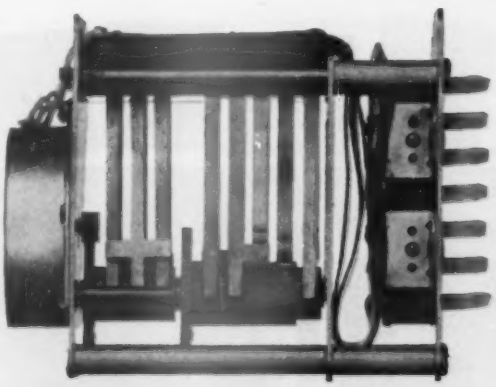
▶ **New Molectronic Elements**—Radio Corporation of America is experimenting with several new types of solid-state functional elements as part of company's recently-launched molectronics effort. One is a tunnel transistor, an NPN device in which a tunnel diode serves as the emitter junction. Another, called an "oscillator," first reported by Soviet scientists, consists of a semiconductor crystal suspended in a d.c. magnetic field causing it to oscillate. Frequency can be varied by changing magnetic field strength. The oscillator, whose principle of operation is not fully understood, may also find application as a magnetometer. RCA also is experimenting with tiny semiconductor delay line in which the delay can be varied by changing emitter bias level. In combination with additional semiconductor junctions, a completely integrated shift register can be produced.

The following Filter Center items are compiled from reports and informal discussions at the 1960 International Solid-State Circuits Conference held in Philadelphia:

▶ **Low-Noise Superconductive Amplifier**—Superconductive amplifier with a

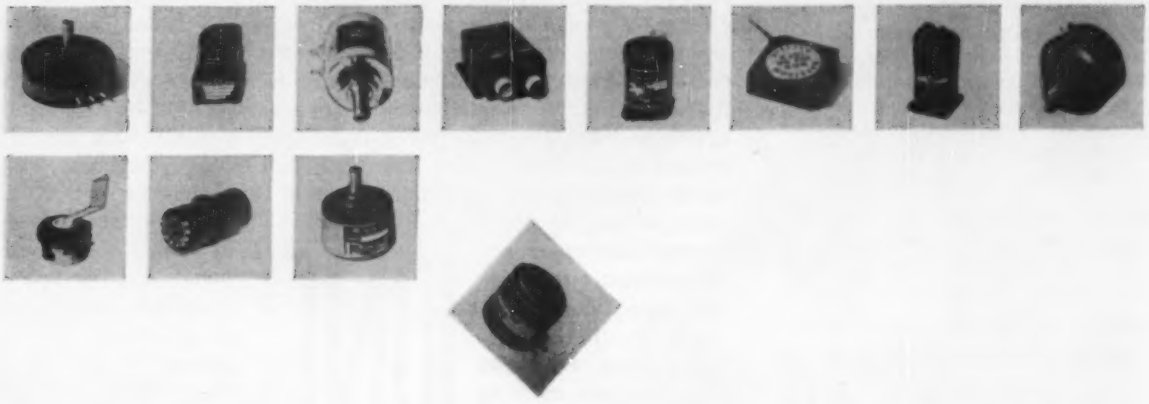
The A. W. Haydon Co. designed this series of repeat cycle timers for engineers with tricky timing problems and tight budgets. The low unit price on quantity runs will surprise you...and the savings we can offer on very large volume production sometimes surprises us! ■ Yet there has been no sacrifice in quality...it's all in the design. Special spring switches are supported in molded contact blocks; cams, cam followers and gears are molded nylon for long service life and extremely quiet operation. Two printed circuit cables supply internal wiring to 12 output circuits, and parallel cam shafts provide two cycling speeds. ■ The A. W. Haydon Co. guarantees this repeat cycle timer for at least one year, continuous operation, and it will actually run for much longer. ■ The unit shown operates at 115V, 60 CPS, 2.5 watts power input. Its switch has been tested for 2 years (125 million cycles at 2 amps resistive 10VAC, 60 CPS) and is rated for 2.5 amp or a 7.0 amp inrush lamp load. ■ To be sure, other variations are available. A. W. Haydon will be delighted to quote these long life, low cost repeat cycle timers in any one of 125 standard speeds, 5 voltage ratings and 3 power supplies. All have Jones type terminal plugs for fast installation, and a quick-change motor mounting for ease of motor replacement. A clear plastic dust cover helps reduce noise level to a whisper. Write for information on your particular requirement.

LONG LIFE LOW COST REPEAT CYCLE TIMERS



THE AWH HAYDON COMPANY
222 North Elm Street, Waterbury 20, Connecticut

COMPONENT KNOW-HOW
THE KEY TO SYSTEMS CAPABILITY



In systems development there is no substitute for experience in component and subsystem design. For more than five years, Daystrom Pacific has been providing gyroscopes, transducers and other basic building blocks for major airborne and missile systems. The development of equally reliable airborne instrument systems has further enhanced Daystrom Pacific's over-all capability.

Backed by its parent organization, Daystrom, Inc., the company has expanded its airborne instrument and subsystem work to include systems development programs that require the competency of an outstanding technical team... the thinking and abilities of an advanced planning group.

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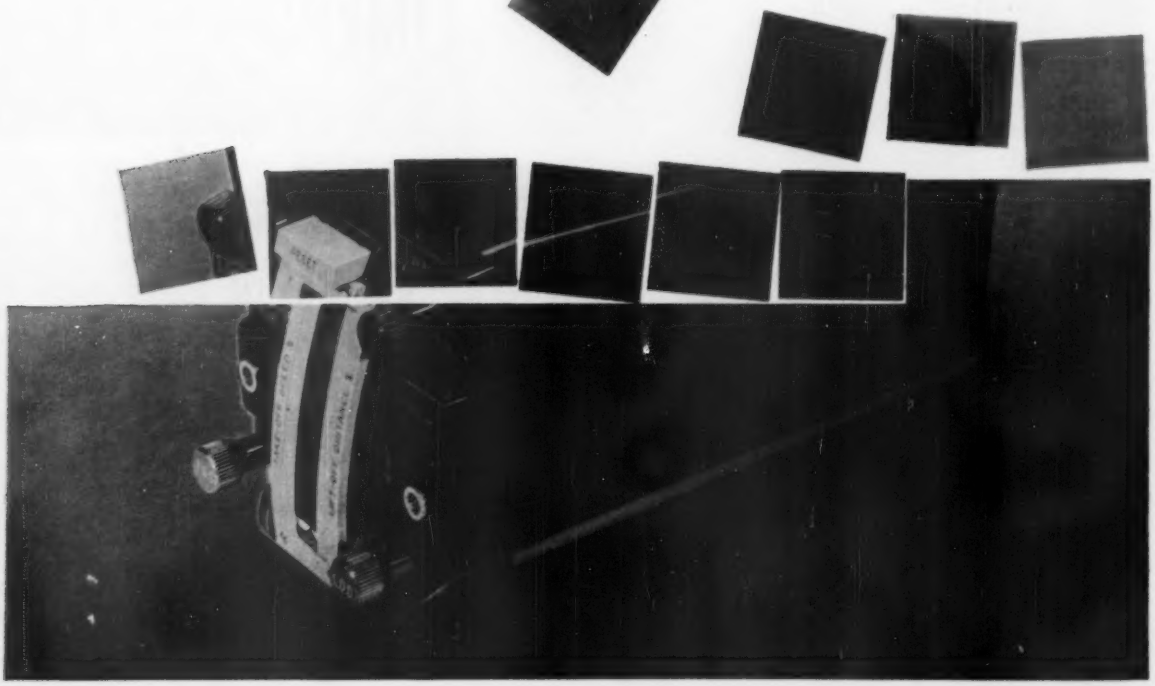

measured noise figure of 0.6 db., gain of 30 db. and operating frequencies up to 1 kmc. was reported by M. Strutt, Institute of Technology in Zurich, Switzerland. Superconducting rectifier which passes up to 3,000 amp. but whose breakdown voltage is as yet undetermined has also been developed. Both are presently low power devices. Original work in wire devices which started two years ago has now been supplanted by films.

▶ **Esaki Diode Enthusiasm Peaking**—Consensus among engineers who have been designing Esaki or tunnel diodes into experimental circuits is that enthusiasm for the new diodes has hit fever pitch in past few months and will wane just as quickly if diodes can't prove themselves in next year or so. Need to stabilize diodes and provide unilateral direction for them still poses thorny problems. Ultimate value, these engineers agree, may boil down to cost—if the diodes can be made and sold cheaply enough, technical problems can be licked.

▶ **Thin-Film Memory**—Watch for demonstration of feasibility of small, deposited thin-film memory by Burroughs Corp. at IRE Convention or Naecon.

▶ **Microminiaturization Programs Pending**—Rash of new microminiaturization programs will be introduced to avionics industry in forthcoming months. Sylvania is set to announce its entry, similar in concept to the micromodule program presently supported by Army Signal Corps. Fairchild Semiconductor to offer solid "micrologic elements"—complete semiconductor logic circuits packaged on single transistor header—to industry this year. Other programs under way at Lockheed, General Electric in Syracuse and Bell Telephone Laboratories in Whippany.

▶ **Inductance Diode**—Semiconductor inductance diode which has potentially large inductance and high-Q was described in a report by J. Nishizawa and Y. Watanabe of Research Institute of Electrical Communication, Tohoku University, Sendai, Japan.

▶ **Tunnel Diode Traveling Wave Amplifier**—Potentially broadband, unilateral traveling wave amplifier was operated recently at Bell Telephone Laboratories. First crude model produces 9 db. peak gain at frequencies above 1 kmc. from a row of four germanium tunnel diodes in a strip-line waveguide. Device uses ferrite strip for unilateral gain and has modest bandwidth of 200 to 300 mc., according to Marion E. Hines who developed device with William W. Anderson at Bell Telephone Laboratories.

From Stratos...

NEW MISSILE AIR CONDITIONER for ground support

HIGH CAPACITY • LIGHT WEIGHT • VAPOR CYCLE

This new ground support air conditioning package by Stratos provides a cooling capacity of 38,000 BTU/hour when equipped with an 8-hp 7,550 rpm motor compressor unit . . . and 50,000 BTU/hour with a 13 hp 11,500 rpm unit. Weighing only 350 pounds complete, measuring just 40" x 24" x 49", and rated at 3.2 or 4.2 tons, the Model VEA4-3 air conditioner amply demonstrates the high capacity that can be achieved in a compact package – due to Stratos' unique Heli-Rotor compressor and efficient evaporators and condensers. The rugged VEA4-3 unit meets military specifications.

Specifications:

Conditioned air flow	80-90 lb/min.
Output Temperature	Automatically controlled 60° to 90° F ±2°
Weight	350 pounds complete with cabinets, charge and controls
Heating Capacity	37,000 BTU/hr. (11 kw)
Electrical System	208 or 416 V. 3 phase, 400 cycle, 4 wire
Cooling Capacity	38,000 or 50,000 BTU/hr.
Controls	Remote panel, cable connected
Refrigerant	Refrigerant 12

STRATOS

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Bay Shore, L. I., N. Y.

HRB-Singer Infrared Recon Photographs May Have Anti-Sub Warfare Application

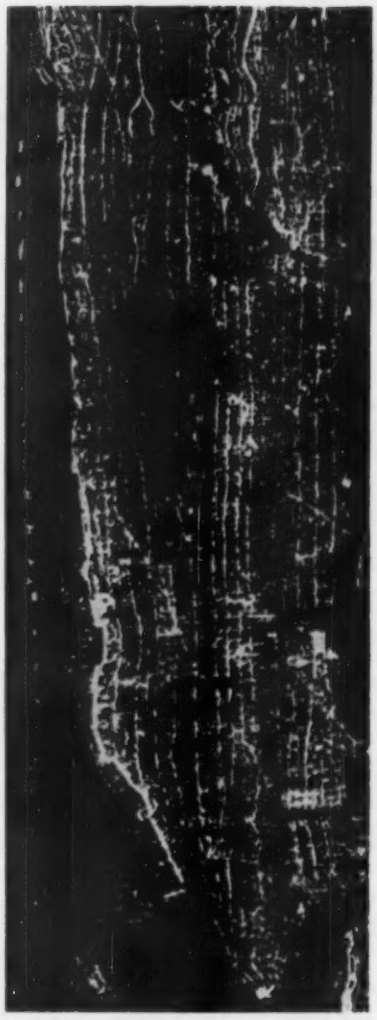
Significant improvement in infrared reconnaissance state-of-the-art since the early 1950s is pointed up by infrared photographs just released by Department of Defense. Aerial photo made of Manhattan Island (left) from an altitude of 4,000 ft. at 11 p.m. with an infrared Reconofax system developed by HRB-Singer, Inc., subsidiary of Singer Manufacturing Co., shows high definition and resolution obtainable in early 1958, when the photo was made.

Electrical powerplants with their high temperature boilers stand out like beacons, appearing as intense spots of light. Ships in the Hudson River also are clearly visible, as is the Times Square area. Equipment can detect slight difference in temperature between water alongside the ship and water temperature in the wake, indicating direction of vessel movement. This suggests possible application of infrared reconnaissance for anti-submarine warfare.

The HRB-Singer infrared reconnaissance system, developed under sponsorship of Wright Air Development Division's Aerial Reconnaissance Laboratory and the Army Signal Corps, is an infrared adaptation of an earlier visible light recon system developed by the company. Infrared photo is produced on a moving-strip film whose speed is varied as a function of aircraft/drone speed over the ground.

If airborne rapid-processing of film is incorporated in the system, and a radio data link transmitter is added, the infrared reconnaissance photos can be transmitted to ground stations within a few seconds after photo has been made. This application of infrared system currently is under development for use by Army for battlefield reconnaissance.

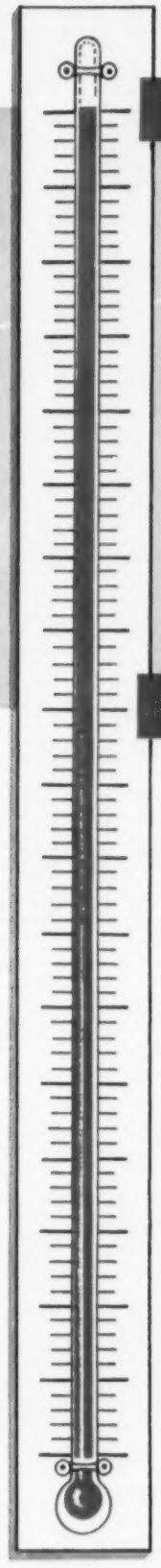
HRB-Singer is actively engaged in development of both infrared and electromagnetic reconnaissance techniques and systems. The latter includes rapid-scan radio frequency analyzers and cross-modulation detection techniques.



Manhattan Island, as seen by infrared reconnaissance system developed in the early 1950s by Servo Corp. of America, which showed infrared recon potential.

First infrared photo made by HRB-Singer Reconofax in 1953 shows farmland from an altitude of 1,000 ft., taken at 5 p.m. System used a lead sulphide infrared detector, which was an outgrowth of a photo reconnaissance system developed earlier by HRB-Singer.

Metallurgical Memo from General Electric



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René 41 is available in strip, sheet, bars, wire, and in forgings, plates or billets. It can be readily machined, forged, drawn, spun, welded or brazed.

If your problems center in the high-temperature range, write for all the facts on G-E high-purity vacuum-induction-melted alloys. Feel free to phone for the on-the-job assistance of a G-E engineer. *Metallurgical Products Department of General Electric Company, 11107 E. 8 Mile Ave., Detroit 32, Michigan.*

*René 41 is a trademark of the General Electric Company

Operator checks molten alloy in furnace beneath him where temperatures range from 2500° to 3000° F. Vacuum-induction melting makes René 41 or any composition virtually free from impurities and inclusions which reduce causes of premature structural failures.

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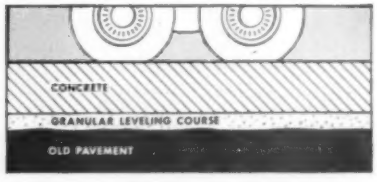
Runways at Chicago's O'Hare Field now converted to jet use

by an overlay of CONCRETE



With concrete, the strength is in the concrete itself. It is not just a smoothing overlay. Loads can be computed *mathematically*. With the bearing values of the soil plus the old pavement at O'Hare, 11 inches of concrete did the job—a big savings. Because the flexible pavement had become channelized and rutted, a 3-inch granular leveling course was used to insure uniform concrete thickness.

Resurfacing with concrete turns old runways into new. . . brings them up to jet-age needs

At Chicago-O'Hare International Airport, they simply covered the flexible pavement with modern concrete. With the old pavement serving as a subbase, 11 inches of concrete gives the necessary strength to handle the heaviest jet wheel loads expected.

The *beam* strength of concrete makes such overlays possible. Concrete is the only paving material that can be precisely designed to match *future* loads. That's why concrete runways can be expected to last 50 years and longer. There won't be any waviness or channelization, even under 150-ton jet airliner weights. And concrete withstands the heat of jet blasts, and the action of spilled fuel, as no other pavement can.

Concrete is the high-safety pavement — pilots themselves will tell you this. It is light-colored for maximum visibility. Its grainy surface means dependable skid resistance and better braking. Concrete creates no dragging action on take-offs.

These material and engineering advantages that make modern concrete ideal for airports make it unexcelled too, for highways of every class. Mile after mile of concrete across the country proves it can do the job better—and do it for less money in the long run!

PORTLAND CEMENT ASSOCIATION

A national organization to improve and extend the uses of concrete

Navy Contracts

Following is a list of unclassified contracts for $25,000 and over as released by U. S. Navy contracting offices:

AVIATION SUPPLY OFFICE, 700 Robbins Avenue, Philadelphia, Pa.

Goodyear Tire & Rubber Co., Akron, Ohio, wheel assemblies, main, for F4D-1 aircraft, N383-62669A(383/211198/60), $136,607.

Hamilton Standard Division, United Aircraft Corp., Windsor Locks, Conn., bearings and valves, to support fuel controls for various aircraft, N383-62586A(383/256113/60), $27,162 and blade assemblies, to support propellers for various aircraft, N383-62579A(383/253521/60), $57,720.

Jack and Heintz, Inc., Cleveland, Ohio, armature assemblies, used on generators for various aircraft, N383-62574A(383/212211/60), $41,372.

Hamilton Standard Division, United Aircraft Corp., Windsor Locks, Conn., barrels and blade assemblies, to support propellers for various aircraft, N383-62565A(383/253507/60), $124,496.

United States Gauge Division, American Machine & Metals, Inc., Sellersville, Pa., indicators, airspeed, to support various aircraft, N383-62580A(IFB 383-288-60), $38,293.

Aerial Machine & Tool Corp., Long Island City, N. Y., belt assemblies, troop and turret gunner's safety, N383-62385A(JD-IFB-383-320-60), $42,583.

Continental Chemical Co., Sacramento, Calif., compound, carbon cleaning to remove carbon from components of internal combustion engines, N383-62543A(JD-IFB-383-254-60), $49,198.

Loral Electronics Corp., New York City, test sets, for checking various radio receivers, N383(MIS-383)-61638A(383/232791/60, MIPR 36-600-OIL-50), $49,942.

Northeastern Engineering, Inc., Manchester, N. H., frequency meters, for electronic testing of radio and radar sets, N383 (MIS)-62417A(MIPR 23-604-0-6625-1019), $435,354.

Hamilton Standard Division, United Aircraft Corp., Windsor Locks, Conn., valves, ram air, for F8U-1, -1P and -2 aircraft, N383-62113A(383/212013/60), $91,550.

U. S. Science Corp. Division, Topp Industries, Inc., Los Angeles, Calif., amplifier assemblies, for angle of attack systems, F4D-1 aircraft, N383-62347A(383/216590/60), $27,803.

Vickers, Inc., Detroit, Mich., repair kits, pump overhaul for F3J-4B aircraft, N383-62136A(383/213194/60), $30,759.

Hamilton Division, Bendix Aviation Corp., Hamilton, Ohio, services and materials to repair, overhaul and/or modify as indicated and place in operation, condition-fuel controls, N383-61521A(383/256101/60), $320,504.

Gordon Enterprises, North Hollywood, Calif., services, materials and parts to repair and place in operating condition, cameras, motion picture, N383-61506A(383/725/59), $59,838.

Pastushin Industries, Inc., Los Angeles, Calif., kits, to rework 150-gal. drop tanks from part number drawing 5548328-501 to part number drawing 5548328-503, N383-61460A(383/217006/60), $154,371.

Solar Aircraft Co., San Diego, Calif., tailpipes, structural airframe spare parts for TV2 aircraft, N383-60868A(383/222398/59), $63,839.

Precision Instruments Division, Western Gear Corp., Lynwood, Calif., gear boxes, to support engine accessories section of P2V-5 and P2V-7 aircraft, N383-62653A(383/211381/60), $38,178.

Hamilton Standard Division, United Aircraft Corp., Windsor Locks, Conn., rotors, to support starters for various aircraft, N383-62349A(383/256099/60), $49,768.

Stewart Steel Products, Inc., Brooklyn, N. Y., tow bars, aircraft, front and rear towing, universal, N383-62379A(JD-IFB-383-142-60), $72,646.

George Senn, Inc., Philadelphia, Pa., compound, carbon cleaning, to remove carbon from components of internal combustion engines, N383-62541A(JD-IFB-383-254-60), $40,768.

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*Patent pending

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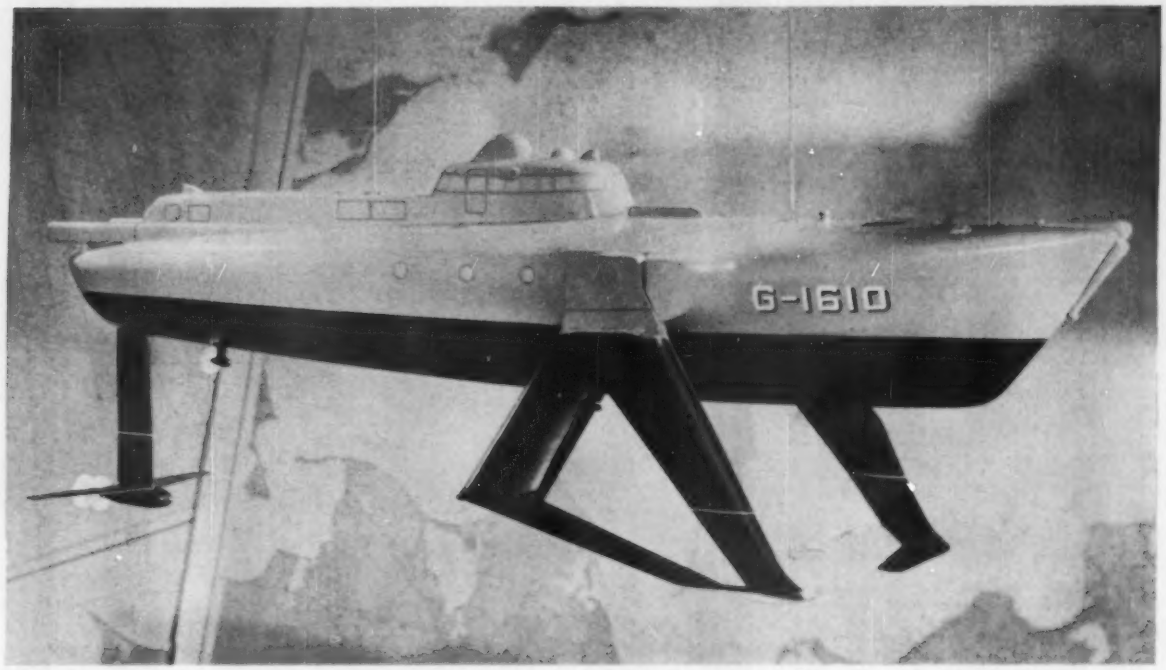


GRUMMAN hydrofoil concept envisions two struts on forward hull section and a single submerged foil on the stern.

Major Aviation Firms Survey Hydrofoil

By J. S. Butz, Jr.

Bethpage, L. I.—Maritime Administration award of a hydrofoil boat development contract to a Grumman Aircraft Engineering Co. affiliate keynotes a significant effort among major aircraft companies to move into this new shipbuilding field.

Grumman got into the field when its affiliate, Dynamic Developments, Inc., was awarded a $1.5 million fixed price contract to deliver an 80-ton hydrofoil craft with a guaranteed 60 kt. top speed by June, 1961 (AW Feb. 1, p. 42).

Several aircraft firms are now interested in a Navy competition for development of a 45 kt. Patrol Craft, Hydrofoil (PCH). Bureau of Ships is scheduled to choose a contractor in the near future, and aircraft firms face tough competition from the shipbuilding industry which is pushing hard to get into this field as it begins to receive serious government support.

Other aircraft companies beside Grumman which are reported interested in the PCH competition are Lockheed Aircraft Corp., the Martin Co., North American Aviation and Boeing Airplane Co.

Maritime Administration is convinced that a large market for ocean-going hydrofoil boats will develop almost immediately in the wake of the sea trials planned for the Grumman boat in the summer of 1961. General optimism surrounds the Maritime Administration-Dynamic Developments project because extensive experience with many types of hydrofoil design has accumulated since the last century, and considerable progress has been made since World War II.

Greatest amount of hydrofoil research probably has been conducted in the U. S., largely with Office of Naval Research support. Present commercial hydrofoil boats were all made abroad, however, and they are used in relatively protected water, primarily in Switzerland, Italy and Russia.

Key Objectives

Key objectives of the current Maritime Administration project are:

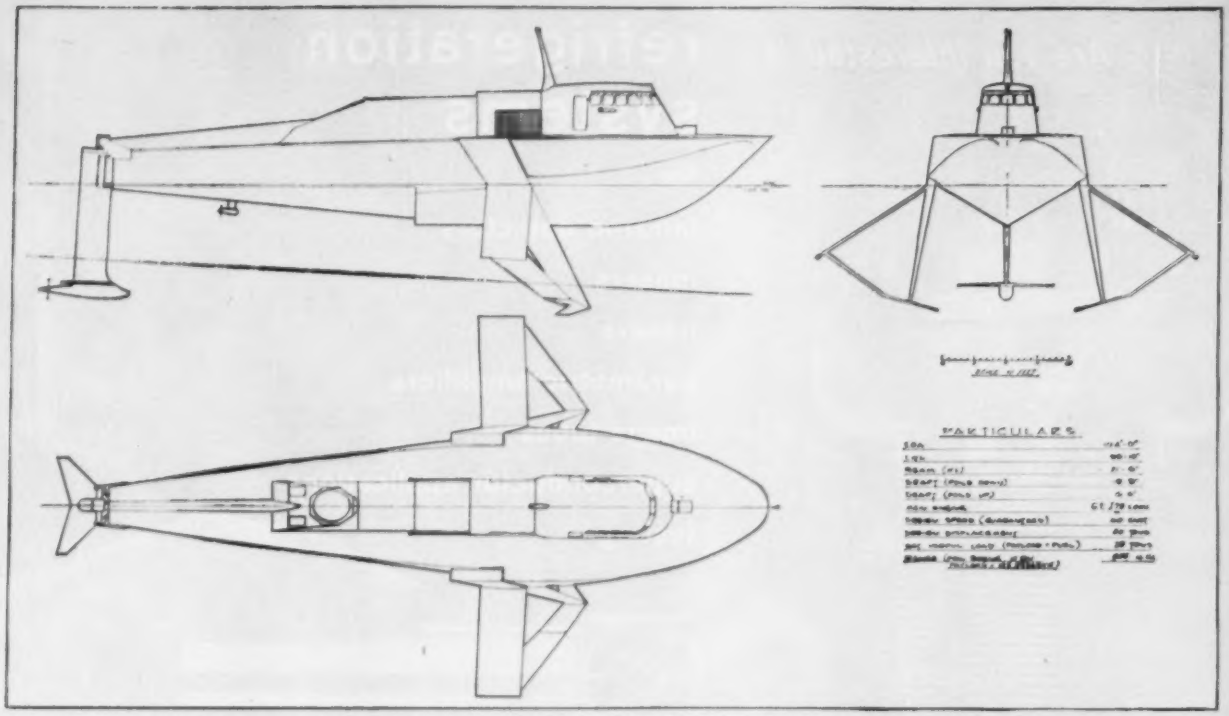
• **Conclusive demonstration** that a large hydrofoil craft can operate in all weather, as has been indicated by research with smaller boats, even though the hull will be in water in a small percentage of sea states. Success of the 80-ton boat is expected to prove the feasibility of hydrofoil ocean liners 500 tons and larger which can carry 500 or more passengers at speeds of better than 100 mph.

• **First use of aircraft turbine** engines on large hydrofoil craft, cutting the installed weight of the powerplant and its transmission system by a factor of about five.

The Grumman boat will be powered by a modified General Electric J79 turbojet (designated the Model 240) with a free turbine wheel to take out about 98% of the energy in the exhaust stream to drive the propulsion system.

Shafting using two right-angle gear boxes will transmit a maximum of 19,250 shp. from the free turbine wheel to a single super-cavitating propeller which will turn up to 4,000 rpm. Total weight of the powerplant installation and gearing will be less than 10,000 lb., and its size is radically smaller than reciprocating equipment of the same power. Ten Pratt & Whitney R2800 engines, for instance, would be needed to provide equivalent power.

When the hydrofoil craft is operating as a displacement boat, (for docking, low speed harbor navigation and during high sea states), a 900 shp. auxiliary turbine will be used for propulsion. This engine, a version of the General Electric T58, called Model 720, will provide ample power for maneuvering the boat in the displacement condition, thus avoiding the inefficiency of using the J79 for this purpose.



RANGE of this sub-chaser design would be 655 naut. mi. at a design speed of 60 kt. Draft with foils up is 6 ft. 6 in.

Potential

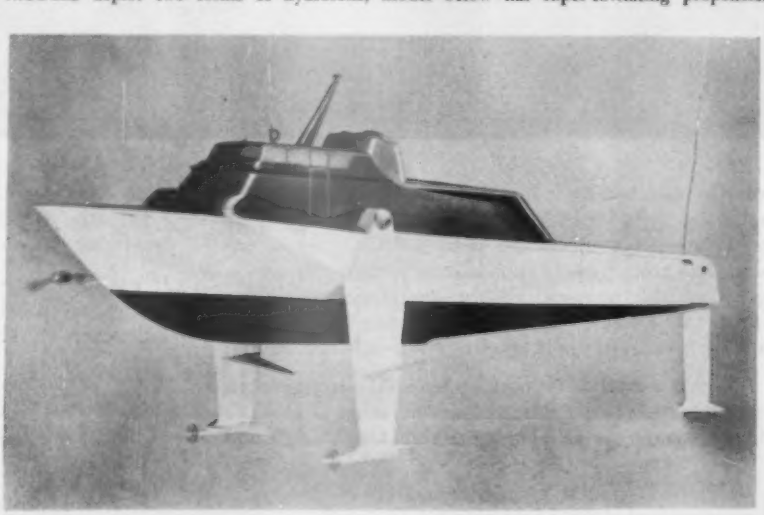
Financial arrangements for the Maritime Administration project are a good indication of the confidence Grumman and General Electric have in the potential of the turbine-powered, seagoing hydrofoil. The $1.5 million from the Maritime Administration will cover less than half the delivery cost of the boat, and Grumman and General Electric are supplying the balance. General Electric Gear Division in Lynn, Mass., is providing the shafting and gear boxes.

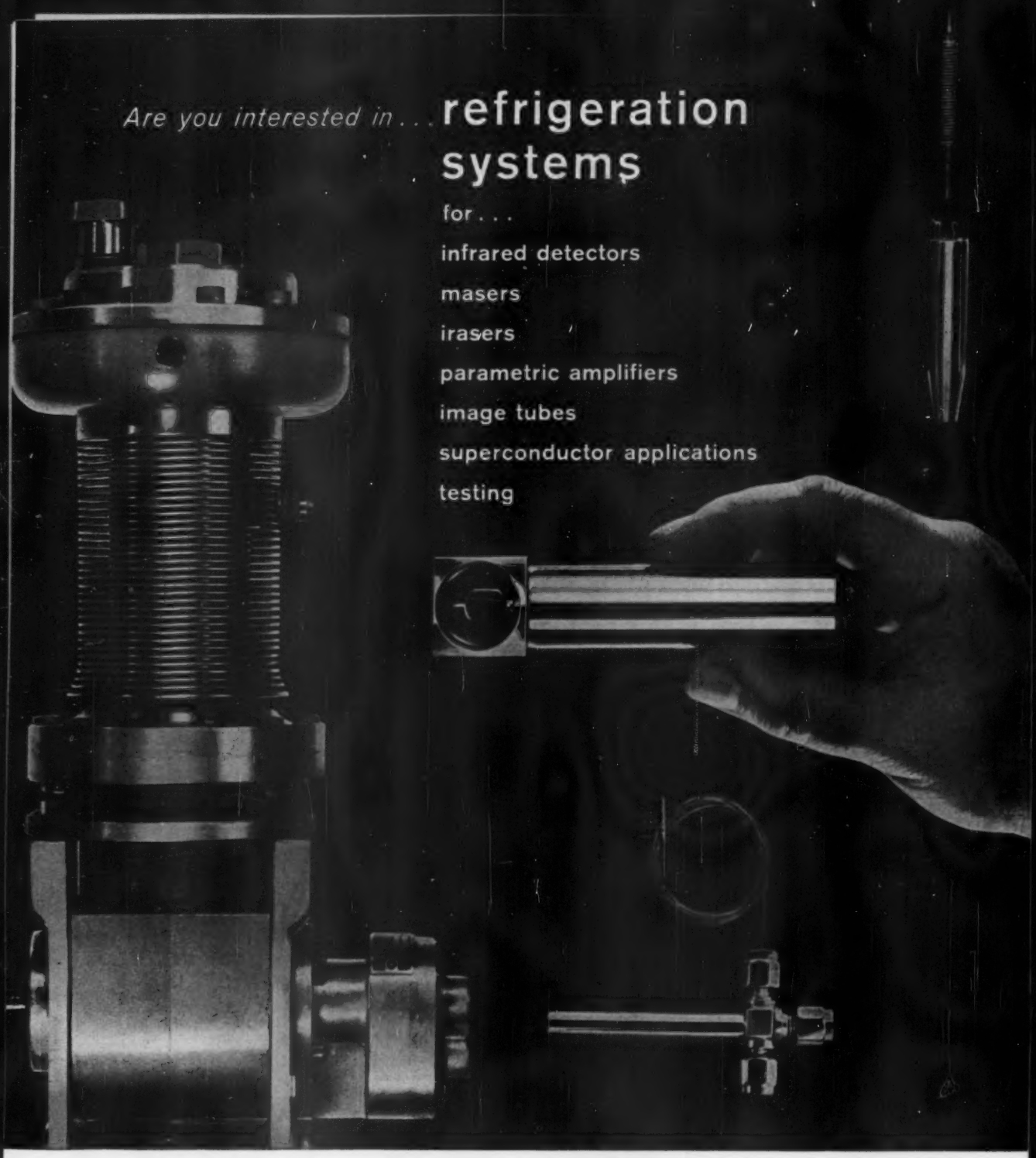
Hydrofoils used on the boat are basically the same ones that were developed and patented by William P. Carl and the company he founded, Dynamic Developments, Inc. Grumman acquired a 50% interest in Dynamic Developments in 1956. These hydrofoils are the surface-piercing type, and they were used on the Office of Naval Research XCH4 hydrofoil boat built by Carl which could run at sustained speeds of more than 90 mph.

The Carl design uses two main sets of surface-piercing hydrofoils ahead of the boat's center of gravity, with a single completely submerged foil on the stern supported by two vertical struts. The forward foils will carry about 80% of the boat's weight.

Sub-cavitating foils will be used on the Maritime Administration boat, and it is expected that they will keep the

MODELS depict two forms of hydrofoils; model below has super-cavitating propellers.





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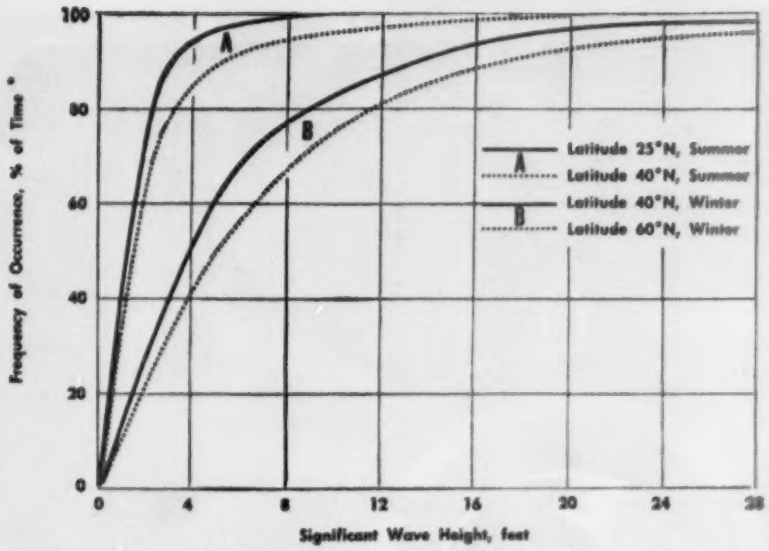

GRAPH shows varying frequencies of waves in the Atlantic Ocean in summer and winter.

top speed under 80 kt. A large bubble of water vapor forms a cavity on the top surface of the hydrofoil as the local pressure drops down to the vapor pressure of the water. On sub-cavitating foils, this cavity forms and collapses at a high frequency and will erode and shake the foil. This action limits the speed of this type of hydrofoil. The surface-piercing foil design usually delays the onset of vibration because air bleeds down the foil and aids in keeping the cavity of water vapor stable.

Cavitation Solutions

The cavitation problem has been overcome in most countries with the development of the super-cavitating hydrofoil. At high speeds, the geometry of this foil produces stabilizing pressures in the upper surface water vapor cavity so that the cavity remains formed and does not periodically collapse. Boat speeds up to 200 mph. are believed possible with this class of foil.

The super-cavitating foil is shaped much like the blunt-base sharp leading edge airfoils which have been used on aircraft that fly well above the speed of sound. Sub-cavitating hydrofoils resemble subsonic airfoils with rounded leading edges and sharp trailing edges.

The Maritime Administration boat will be stressed for speeds above 100 mph. so it can be used to test a super-cavitating foil system if the money becomes available to test one. A large amount of excess power is also available for higher speed research since only about 10,000 shp. will be required using the sub-cavitating foil system at 80 kt., with almost that much more still available from the J79.

Ultimate hydrofoil system, in the opinion of most marine engineers and hydrodynamicists, will consist of fully submerged foils attached to the boat by vertical struts. The incidence of these foils will be controlled by an autopilot so the center of gravity of the boat will remain steady as it moves through rough water. The surface-piercing foil system for the Maritime Administration boat has natural stability in roll and yaw through the dihedral angle of its foils. The fore and aft placement of its foils provides a natural stability in pitch. This system, however, does produce oscillations of the boat's center of gravity which are not unpleasant under most sea state-speed combinations but which are objectionable under some conditions.

The autopilot which is required to keep the submerged foil system stable has been under development for some years. It uses some type of ultrasonic or radar sensing unit on the bow to feed a description of the waves just ahead of the boat into the autopilot so the incidence of the foils can be adjusted to maintain level flight as wave height and direction of flow change. Adequate autopilots and submerged foil systems are believed to be available as soon as they are called for by the military or commercial firms.

One of the big controversies surrounding the current Maritime Administration and Navy PCH hydrofoil boats is hull design. There are two main schools of thought, with one contending that the hull should be built like a seaplane bottom and the other holding that it should be built like a destroyer.

Load Transmission

The advantages of the seaplane type construction are high strength-to-weight ratio, which is as important to vehicles supported by hydrofoil as it is to those supported by wings, and the ability to take high impact loads that normal boat bottoms are not designed to take. The "V" bottom of a seaplane with its high dead rise angle transmits a small load to the rest of the hull when it plows suddenly into a heavy sea in comparison with the load transmitted by the relatively flat bottom of the destroyer. As a consequence, destroyers and other naval vessels have to slow down in heavy seas due to the pounding on their bottoms when they pass through waves.

One of the arguments for the destroyer-type hull is that it has better sea-keeping characteristics, which will be useful during the times that the

GRUMMAN'S 100-kt.-capability hydrodynamic test facilities now in use for foil tests.

IMPORTANT DEVELOPMENTS AT JPL

GAS LUBRICATION

Research in gas lubrication and on performance and application of gas bearings is an important current activity at Jet Propulsion Laboratory.

The photographs shown are actual visualizations of gas flow patterns (obtained by an ultraviolet fluorescence technique) on a shaft under varying loads. Those on the left show pattern on an unloaded bearing — those on the right when bearing is loaded under 80 lbs. at 40 psig supply pressure.

These research experiments relate directly to the use of frictionless bearings in space vehicle components.

This is another example of the variety of supporting research and development being carried on at JPL to advance the national space exploration program.

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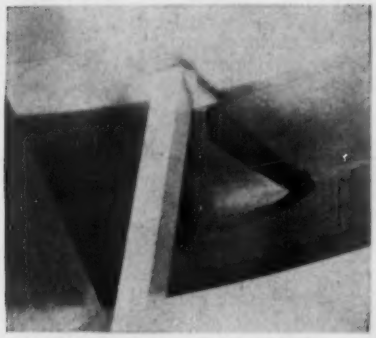

FOIL shape is placed in test facility for water states study.

seas are so rough that the hydrofoil cannot get up on its foils and must be used as a displacement boat. This is answered by the proponents of the seaplane type hull by the demonstrated stability of the hydrofoil boat when its foil system is completely submerged into the water. The deep-riding foils have proven to be just as effective as gyroscopically controlled horizontal stabilizing foil systems for surface ships.

The hull of the Maritime Administration hydrofoil boat will have a seaplane bottom complete with step and high-dead rise angle. Its aluminum, all-welded construction will be of aircraft style sheet metal design using relatively closely spaced frames and stringers to take the high density internal loading situation common to boats.

It will be stressed to hit a wave at more than 100 kt. in the event that one of the foils sheared away.

Water propellers of the super-cavitating type will probably be used on all heavy hydrofoil boats. Air propellers are considered more advantageous for lightly loaded boats.

Large numbers of hydrofoil craft were designed and evaluated during World War II by German army and navy. Hanns von Schertel, now associated with a Swiss hydrofoil firm, Supramar A.G., was active in the program. The boats ranged between 4 and 80 tons and reached speeds up to 50 kt.

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Sundstrand's new combination jet engine starter offers advancements of singular importance to using commands concerned with the alert mission concept and secondary airbase mobility.

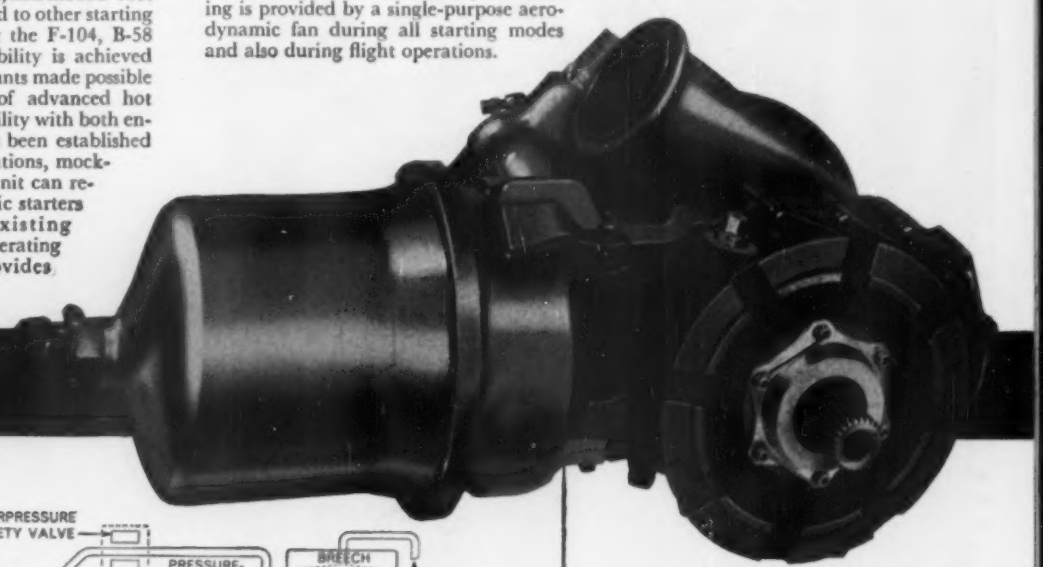
SAFETY: In each starting mode—cartridge, high-pressure bleed air, and low-pressure ground cart air—nine fail-safe features protect personnel, aircraft and starter against multiple cascade failures (see Figs. 1 and 2).

VERSATILITY: The basic starter is completely interchangeable for the F-100, F-101, F-105, B-52 series, and the KC-135. It is also readily adapted to other starting requirements including the F-104, B-58 and GAM-77. Adaptability is achieved by alternate breech mounts made possible through development of advanced hot gas circuitry. Compatibility with both engines and airframes has been established by actual starter installations, mock-ups and studies. The unit can replace present pneumatic starters without changing existing starter systems or operating procedures, and provides parallel, self-contained cartridge mode.

STATE-OF-THE-ART ADVANCES: Pressure-limiting valve controls cartridge burn rate to obtain desired combination of starting torques and times—provides consistent starting torques from —65°F to +160°F—controls burn pressure during start to compensate for erratic cartridges. Overpressure safety valve can be 100% inspected and is resettable to eliminate nuisance removals. Integral throttling duct controls pressure ratio across turbine—pressure regulating valve not needed for pneumatic starts. Speed limiting is provided by a single-purpose aerodynamic fan during all starting modes and also during flight operations.

LIGHT WEIGHT: Sundstrand engineers have designed the new starter into a compact, lightweight module that weighs less than 60 pounds.

The Sundstrand cartridge/pneumatic starter has firmly established its capability through actual engine starting tests on the basic J-57 series at Air Force installations, and is the first unit to successfully start the ducted fan version for the B-52H. Based on analysis of starting torques and times requirements, the basic starter is also adaptable to the J-52, J-75, and J-79 engines.



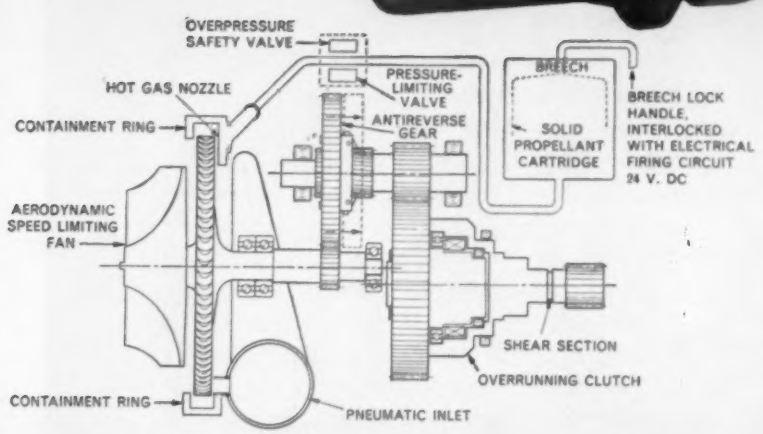


Fig. 1—Schematic drawing of Sundstrand cartridge/pneumatic jet engine starter. Illustration shows simple, compact spur gear, single jackshaft gear reduction, movable breech, and nine components of cascade fail-safe design.

Fig. 2—Outline showing sequence of cascading safety features. Nine fail-safe systems provide optimum protection for personnel, aircraft, and starter.

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STABILIZING VANES extend from B-70 escape capsule fuselage; note gas bag (filled, left) which breaks landing impact.

Encapsulated B-70 Ejection Seat Tested

By Irving Stone

Inglewood, Calif.—Feasibility of an encapsulated cabin seat to permit survival for crewmen of the North American Mach 3 B-70 intercontinental bomber has been established in more than 60 unmanned parachute drop tests.

The encapsulated seat, which will be used by each of the four crewmen—pilot, copilot, bombardier-navigator, and defense system operator—has clam-type doors that snap shut from top and bottom, providing an airtight seal which eliminates requirement for an oxygen mask or pressurized flying suit.

With the airplane operating at altitudes above 70,000 ft., crew members would sit in a "shirt-sleeve environment." For emergency, the seats convert into capsules to enable the plane to be brought to lower altitudes where crewmen could survive without the capsule's protection. If it was necessary to abandon the aircraft, each encapsulated crew member would be propelled through escape hatches. Clear of the airplane, a 34-ft. nylon chute would be deployed to lower the capsule. Landing shock would be absorbed by a large gas-filled rubber bag on the bottom of the seat.

If landing is made in calm water, the

NORTH AMERICAN test pilot Al White demonstrates seat action in a capsule mockup.

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This sounds like a lot to ascribe to a door seal, but it does play a really important part. The F-27B's for Northern Consolidated Airlines must be ready to roll in spite of —50 F ground temperatures. Their passenger doors and big cargo doors need Silastic seals because Silastic stays rubbery down to —130 or up to 500 F. With an organic rubber seal, the doors wouldn't open and close at —50. Silastic also resists equatorial weather, and springs back to shape after being compressed under load. So when the door opens to load either passengers or cargo, it will come shut again on a reliable seal that keeps its original properties and holds cabin pressure.

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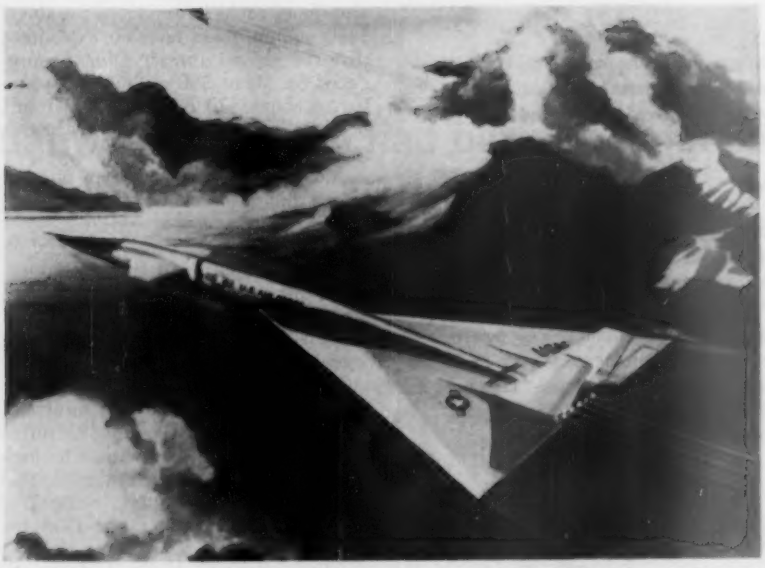

AIR FORCE artist's conception of the B-70 Valkyrie is the first official view of the Mach 3 bomber and confirms configuration rendered by Aviation Week artist in the Dec. 7, 1959, issue (p. 26), shown carrying a Dyna-Soar vehicle. Funding was cut to $75 million for construction of two prototypes, with some systems still open to review (AW Jan. 25, p. 28).

capsule could float with the doors open. Four air bags would sustain the capsule for more than 72 hr. In a stormy sea, the capsule would float closed. A pop-up radio antenna would permit the crewman to transmit distress signals. If tipped, the capsule has buoyancy and stability to right itself.

A demonstration of the encapsulated seat was performed here by Al White, North American's chief test pilot for the B-70 program. For normal seat use, White sat well forward of the capsule perimeter, with complete freedom for arms and legs. With the pull of a lever, the seat moved rapidly aft and clamshells closed, in effect, putting White in a sealed pressure vessel. In this position, the occupant could trigger the installation and eject the capsule, bringing him to below 15,000 ft. in about three seconds, where the main chute would be deployed. Ejection of the capsule could be from as high as 120,000 ft., it was disclosed, indicating its potential for use with space vehicles after launch or during re-entry.

The seat also is compatible for ejection from runways at speeds of 70 to 90 kt.

Economics and operational highlights of the B-70 were outlined by Program Manager J. J. (Jack) Jones. Cost for the first B-70 operational wing comprising 64 planes—50 basic aircraft plus 14 flight test aircraft which would be funneled into operational use—would be approximately $3¾ billion, encompassing the airframe, equipment, engines, spares, etc. Total of five wings would involve a total cost of about $6.5 billion.

North American is scheduled to produce one prototype aircraft under the present B-70 program. Including flight test, cost of this prototype program will run slightly over $400 million. Two

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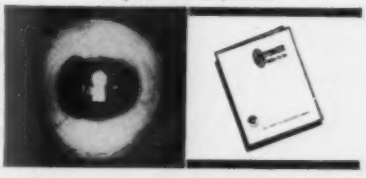
Photo of Rocket Chamber courtesy of Aerojet-General Corporation



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prototypes could be produced for about $440 million, Jones revealed, explaining that the second aircraft could be produced for about $60 million but a saving of about $20 million would result in the flight test program with this second aircraft.

Already more than 9,000 hr. of wind tunnel flight test have been recorded in the B-70 R&D program.

The B-70 has the capability to be on air-alert for hours, but this operational technique would not be advisable since the aircraft could get off the ground rapidly—as fast as any interceptor, in actual time only a "matter of seconds."

Decision was made to eliminate the use of boron fuel in the afterburners of the B-70's General Electric J93 turbojet engines when, in addition to high cost involved, analysis indicated that the aircraft could achieve, using JP-4 alone, a 15% greater range than the goal established by SAC.

Elimination of boron fuel in the B-70 operational scheme permitted substitution of JP-4 tanks for those originally designed to carry the boron fuel. This also will simplify operational techniques by eliminating the need to flush the emptying boron tank with JP-4 to wash out coking which would be deposited on the inside of the tank from heat of the aircraft skin.

Inspection of an environmental full-scale portion of the B-70 fuselage crew compartment, extending from the cabin window aft to the middle of the canard surface, showed a width of about 6½ ft. of clear internal space at the floor, and a length of about 20 ft. to a pressurized door at the aft end of the compartment. Clear head space in the cabin is about 6½ ft. Just forward of the pressurized door on either side of an aisle is an inclined rail-support for the encapsulated seats accommodating bombardier-navigator and defense system operator.

Channel-section ribs about 4 in. deep and spaced about 8 in. apart stiffen the external skin. A box beam about 5 in. square is located under the top skin decking.

Construction material on this fuselage section is titanium alloy, whereas the bulk of the remaining aircraft structure is stainless steel, incorporating a large proportion of honeycomb sandwich makeup.

X-15 Research Plane Reaches 80,000 Ft.

Edwards AFB, Calif.—North American Aviation's No. 2 X-15 reached 80,000 ft. highest yet achieved in X-15 test program—after a drop from a Boeing B-52 at 45,000 ft. Scott Crossfield took the ship to Mach 2 in 10 min. free flight with 4 min. under power.

Baby's first breath had better be a good one . . . after that we can help. In the early hours of life, if he happens to be premature, he will need a Beckman oxygen analyzer with his hospital incubator to prevent retrolental fibroplasia — a disease that can result in blindness. ● Helping to control the air he breathes will always be a part of our job — in factories, in atom-powered submarines or in what used to be the great outdoors. He won't like smog . . . and we're working on that problem too. ● His food will be fresher and tastier because a Beckman pH meter played a part in its growing and processing. The clothes he wears will look better, last longer because of Beckman Instrumentation. No matter how far he goes or how high he flies, we'll be there with him . . . with everything from events-per-unit-time meters for measuring engine speeds, to servomotors for his automatic pilot. ● There's scarcely a life that isn't touched by Beckman research, development, manufacture and service. We'll help baby all right.

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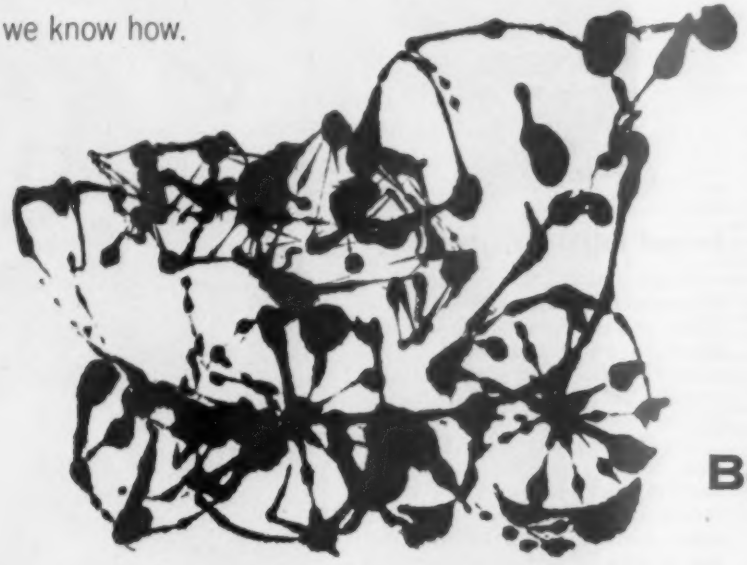

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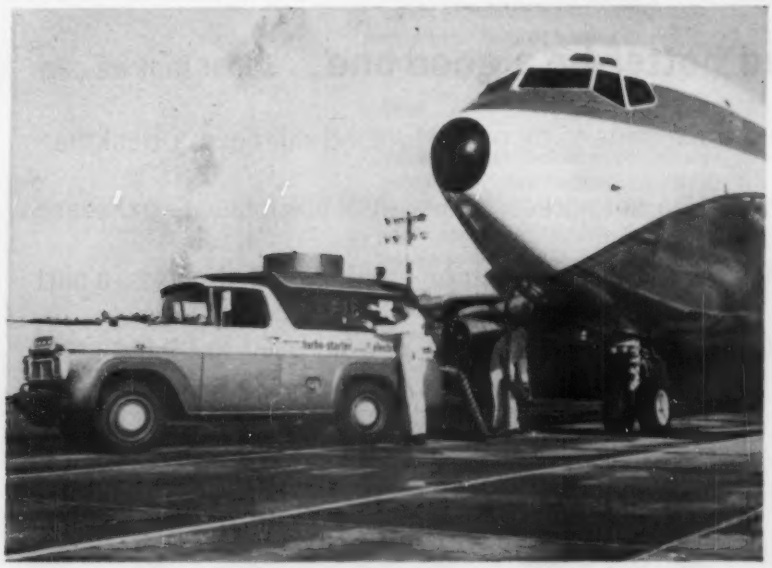

Pneumatic Starter Truck Supplies Electrical Power

Panel truck containing a Boeing gas turbine driven compressor for providing starting air to jet transports also carries a General Electric 60 kva. 400 cps. alternator for electrical ground support. The turbo-compressor is located in rear and the alternator beside the driver. The alternator is powered by the Ford truck's 332 cu. in. V-8 engine at 3,000 rpm. The unit was developed by Boeing Industrial Products Division and General Electric.

Lightplane Ice Detector

Ice formation on aircraft wings may be detected with an inexpensive optical device.

The detector consists of two translucent plastic rods placed in parallel a fraction of an inch apart on the aircraft wing. A light is beamed into one rod; a photoelectric cell monitors the other. The formation of ice causes the light, which is usually trapped in the source rod, to refract into the second plastic rod thus activating the photoelectric cell. The thicker the ice buildup, the more light refracted and the greater the current produced by the cell.

Armour Research Foundation, Illinois Institute of Technology, Chicago 16, Ill.

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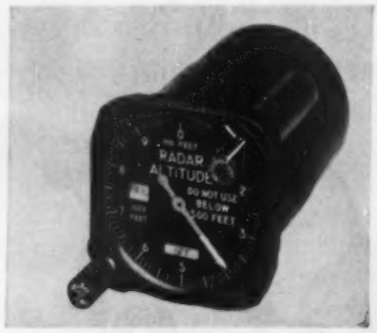
Inverter, developed for the Air Materiel Command, has a voltage regulation accuracy of plus or minus 0.87% and an efficiency of 85%.

The unit converts 28 v.d.c. to 115 v.a.c. at 400 cps. within a temperature range of −55 to +125C. Frequency accuracy + or −½ cps. has been achieved with a stable frequency reference. The frequency source also controls the phase relationship. The inverter, with no moving part, weighs under 5 lb.

Electronics Department, Hamilton-Standard Division, Broad Brook, Conn.



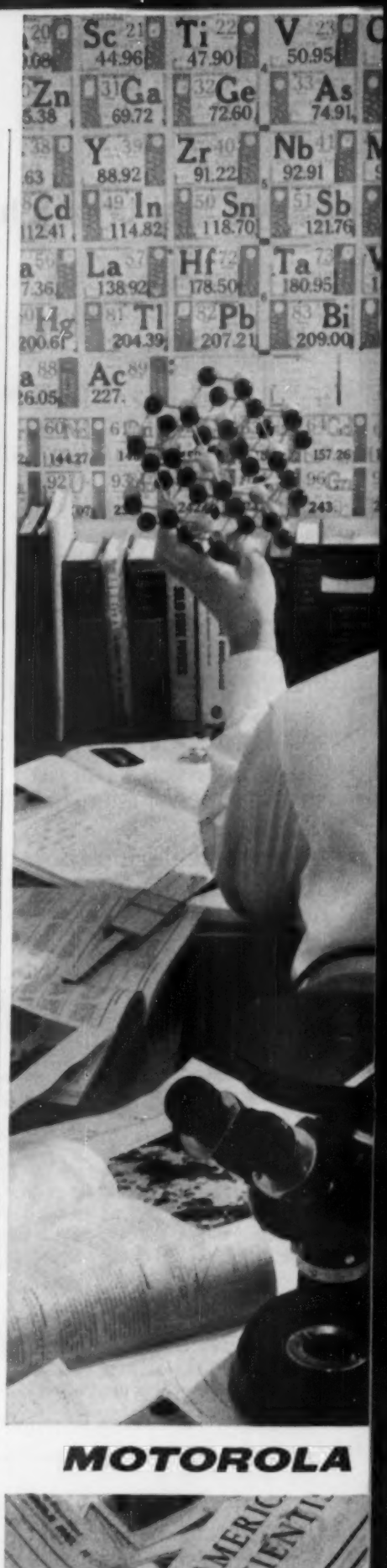
Servoed Height Indicator

Height indicator shows height above the ground from zero to 100,000 ft. Two drums on a counter indicate altitude in thousands and ten thousands, and a pointer and dial depict altitude between zero and 999 ft. The instrument is not for use below 500 ft.

The T8610-11 has 1x and 25x synchro control transformers, a diode switching network, an A3105 transistorized servo amplifier and a motor generator driving the transformer, pointer and counter. Power requirements are: motor generator 26v., 400 cps.; amplifier, 28 v.d.c. Pointer rotation rate is 1,250 fps. (in either direction).

The indicator meets MIL-A-8224A and environmental performance meets MIL-B-5272B.

Kearfott Division, 1150 McBride Ave., Little Falls, N. J.



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Beech Speeds Plans for Turbine Aircraft

By Erwin J. Bulban

Houston Tex.—Business aircraft development and marketing programs under way at Beech Aircraft Corp., Wichita, Kan., are aimed at producing a high improvement in the company's position in this fast-growing market in the next five years.

Basic features of this plan have been decided by a recently formed Beech Research and Development Committee and approved by a top-level executive committee, vice president-commercial sales Leddy I. Greever told AVIATION WEEK here at a showing by Business Aircraft, Inc., the company's new distributor in this area.

Turbine Power

One of the decisions reached by the committee is that turbine power, particularly the turboprop, will be seen on production business aircraft, including the light-twin category, many years earlier than had been forecast previously, and that Beech aims to move with this significant development.

"Turboprop-powered business planes are five years closer today than they were a year ago," Greever said.

Although Greever declined to elaborate on Beech plans, his observation—in light of earlier forecasts by business aircraft industry observers that turboprop business planes would probably not appear in significant quantities until the 1965-1970 period—would indicate that Beech now believes that these airplanes will be available in the 1960-1965 period.

Some observers told AVIATION WEEK that the chances are good that Beech will have turboprop-powered airplanes flying in at least two categories, including the light-twin field, in another two or three years.

(A Beech 18, fitted with Turbomeca Bastan turboprops, has compiled considerable test flight time in France [AW Dec. 8, 1958, p. 112]. Turbomeca currently is fitting a Travel Air with Astazou turboprop engines.)

It is evident that Beech will be taking some big strides to meet the bold concepts of this five-year plan, both technically and in marketing. Technically, it appears that the company is developing a wide range of models to make it competitive with manufacturers in the low-to-high-price categories. Although the categories from $5,000 to $350,000 have been mentioned, it appears more likely that these actually are broad price ranges, rather than definitive goals. Chances are that the "$5,000" airplane actually will be closer to $8,000, but this would still represent a major revision of management thinking of the areas that Beech traditionally has encompassed.

Lower Price Market

Debonair four-placer obviously is the first entry in the lower price market Beech will penetrate. Sometime in 1961 there probably will be another airplane flying, bringing Beech into the $15,000 airplane bracket. This probably will be a low-wing metal four-placer with fixed tricycle landing gear.

It appears that the committee thinking is that some basic changes in engineering and production techniques, some feeding out of military aircraft practices, will be used to bring costs down.

One of these techniques will be simplified construction to eliminate costly man-hours and parts. It appears reasonable that the company's engineers will attempt to develop some basic lower-cost assemblies that might be interchangeable between several models.

An example of this could be the wing of the company's four-place category, now represented by the Bonanza and Debonair and later the "$15,000" airplane. These types would be considered a "family" using a basic low-drag, simplified "wet" wing.

Bonanza Growth

With introduction of other four-place models, the Bonanza could be free to "grow"—in three to four years it could go up to 400 hp., get an enlarged fuselage, new wings and tail.

Another airplane that would develop a "family" could be the Travel Air, which would develop into a turboprop version.

The Queen Air also is slated to move into turboprops and get a pressure cabin.

Each one of these steps would probably be planned two years ahead. For example, the new features that will appear on the 1961 Travel Air will not be "frozen" until final decision is made on what the 1962 version of this airplane would look like.

In keeping with plans to greatly enlarge the model line, Beech marketing also will undergo considerable growth. It already is seeking to double its cur-

Non-Roadable Aero-Plane Makes First Flight

Aero-Plane, four-place, non-roadable version of the Aerocar, makes its first flight at Longview, Wash. The tricycle gear aircraft uses the same Lycoming engine and folding wing (for storage) as the Aerocar (AW Nov. 23, p. 116). Elimination of the Aerocar's automotive components provided the weight-saving necessary to carry two extra passengers in the Aero-Plane model, which costs $9,995.

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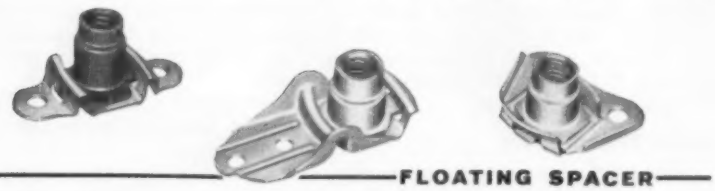

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rent dealer list in 1960. Beech domestic dealers now number 37.

To do this it is encouraging queries from people both in the aviation industry and in other businesses to set up dealer organizations. According to Greever, the company is getting approximately five letters a day from prospects; about half of these are from people outside the industry.

Greever estimates that today, a dealer can get started with approximately $50,000-$75,000 investment – if he rents, rather than builds a hangar. The company would prefer that the prospect put a considerable percentage of his own funds into the venture, rather than rely on backing from wealthy businessmen who may consider the venture as a hobby and not be too concerned with building it to a profitable operation.

Production Rate

Indications are that this move toward building its sales organization will require a higher rate of increase in airplane production—it appears that in Fiscal 1960 Beech deliveries of business airplanes may be approximately 50% higher than in Fiscal 1959. Authoritative sources say that Fiscal 1960 deliveries will approximate some 1,250 airplanes, compared with about 805 last year. This will mean increasing production of every model with the possible exception of the Bonanza. Earlier projections of Fiscal 1960 output ran approximately 1,150 units.

These production jumps will see Beech commercial business closing the disparity now represented by military business—in 1960 the company's commercial business will probably run 50% of its total, and in 1961, it will probably go ahead to represent a 60-40 ratio, with the more profitable commercial business being in the lead.

Sales Example

As an indication of how business airplane sales are climbing, Beech Aircraft's south central region, covering Houston, Dallas, San Antonio, Amarillo, Shreveport, Tulsa and Oklahoma City, has done nearly the dollar volume of Fiscal 1959 in the first four months of current fiscal year, in deliveries and firm orders.

Exemplifying the growth that is occurring in the Beech sales organization to develop this market, its new distributor, Business Aircraft, Inc., at Houston International Airport, has approximately double the facilities operated by the former J. D. Reed organization. Hangar space is approximately seven times greater.

President-general manager Nick Petkas, 38, typifies the new generation of businessmen now stepping into business aircraft distribution. He formerly

COMPLETE CAPABILITY

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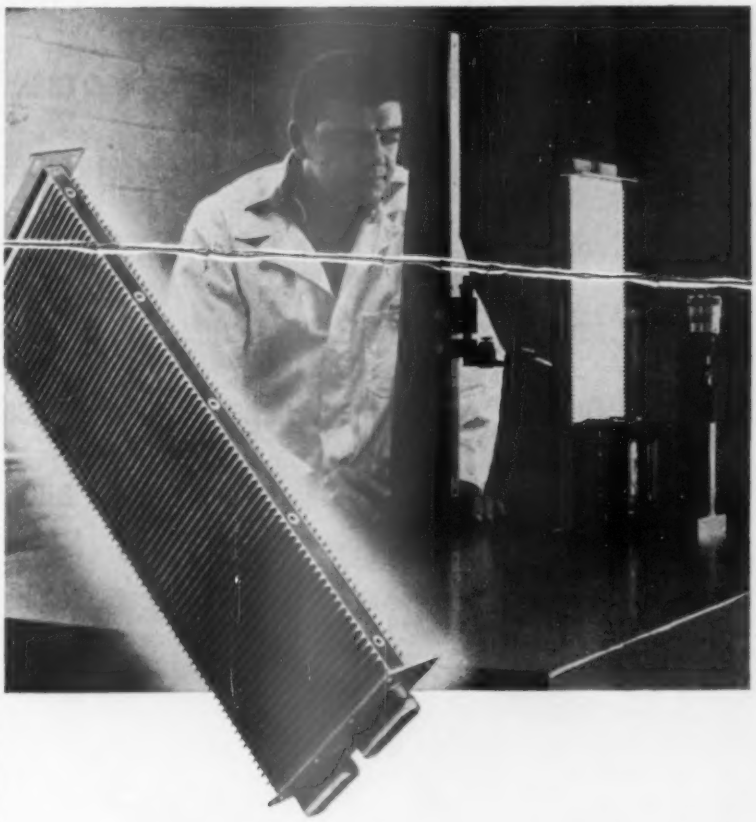

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The story of Alfa and the Skunks—

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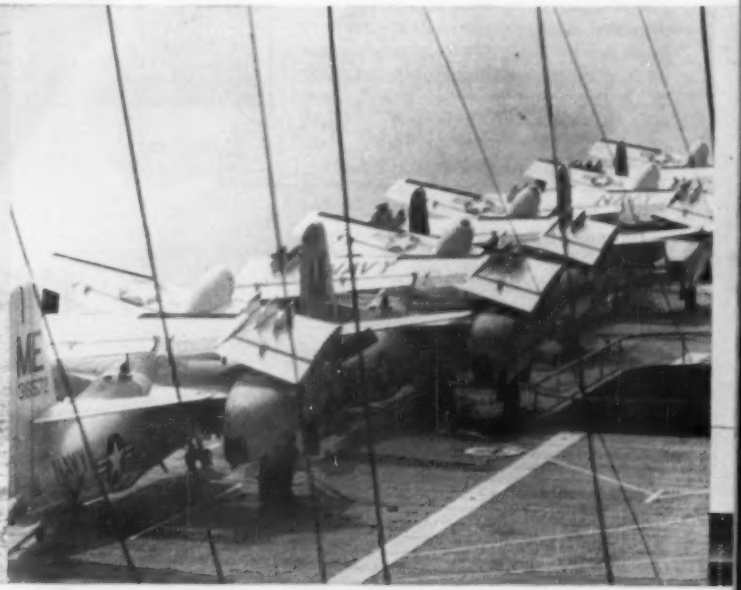
With deadly patience, a helicopter hovers above a suspected submarine and lowers a sonobuoy into the water. Little larger than a football, the sonobuoy transmits any sound impulses from sub back to the helicopter, which can drop depth charges. The cable is specially designed multi-control electrical cable of steel and copper strands manufactured by the American Steel & Wire Division of U. S. Steel. It is the main artery of $1,000,000 worth of detection gear in the helicopter.



These S2F "Guardians" are ideal for long-range, all-weather operations. Engine pods hold sonobuoys; on the wings are seven-million-candle-power JULIE searchlights. It takes 78,000 tons of steel, counting the carrier and her supporting destroyers, to keep the task group's aircraft operating.

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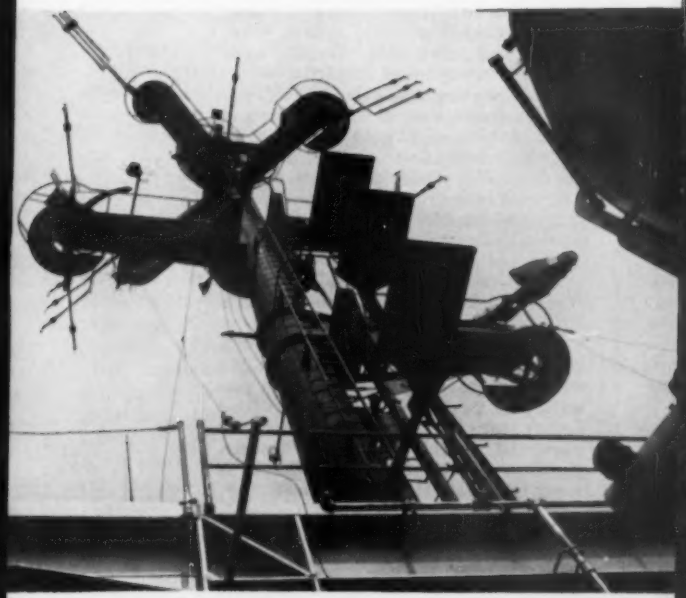

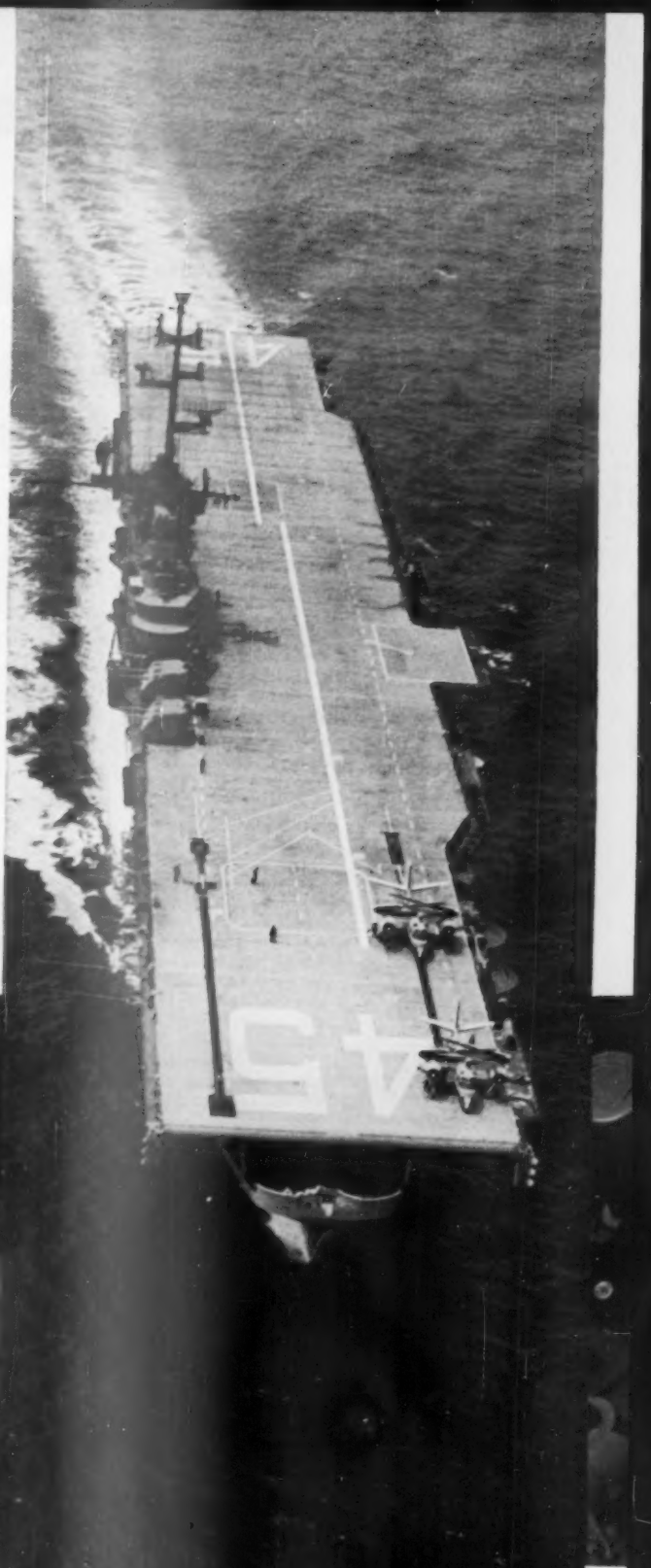

CARRIER VALLEY FORGE's steel mainmast is a maze of electronic devices, including steel radar and radio antennas that keep her in constant touch with all elements of the task group. Her radio can reach around the world. She coordinates all attacks, and has been modified to handle anti-sub helicopters, S2F "Guardian" and AD "Skyraider" hunter-killer aircraft. Although not suited to handle modern Navy jets, VALLEY FORGE's life has been extended by modification to anti-sub work.

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Call collect CRestview 4-8884 and ask for Mr. Jerry Morris. He will arrange an appointment for you with key personnel at the Bedford Laboratory. If you prefer, send your postcard or letter to Mr. Morris, Raytheon Company, Missile Systems Division, Bedford, Mass.

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operated auto washer and parking facilities in Houston. Petkas became aware of the aircraft potential through conversations with his customers, who were largely business executives. He noticed that more and more of these customers discussed company airplanes they had purchased and decided that this was a growing enterprise that he might get into.

A former World War II U.S. Marines fighter and bomber pilot in the South Pacific and instructor in a Corsair squadron on the West Coast during the Korean War, Petkas will put his full time into his new operation, liquidating his former interests.

Investment so far is approximately $500,000—today's Beech distributorship can take from $300,000 to $400,000 and up to $1 million to start—but Petkas has his sights set on a volume of approximately $2 million gross this year and the territory should be one of the top six revenue producers in the country, Beech Aircraft believes.

Business Aircraft covers Houston, Galveston, Bryan, Port Arthur, Lufkin, Beaumont and Lake Charles, plus 43 surrounding counties in Texas and Louisiana.

Aeroflot Develops Air-Drop Containers

Moscow—Russia's Aeroflot has developed a wide variety of inexpensive containers for air-dropping loads weighing up to 2,205 lb., without using parachutes.

Need for such packages is greatest in sparsely-populated areas of the Far North's marshy tundra, where aircraft landings are difficult or impossible and where emergency loads dropped by parachute frequently are carried away from the target area by strong winds.

Latest type of air-drop package to be used successfully is a small, crimped-paper sphere which reportedly can be made from any printing plant's waste paper at a cost of 1 to 10 rubles (10 cents to a dollar at the tourist rate of exchange). The sphere can be transported in folded form "like a fan" but when expanded the inside consists of many paper honeycombs with space in the center for a load weighing from 2.2-6.6 lb.

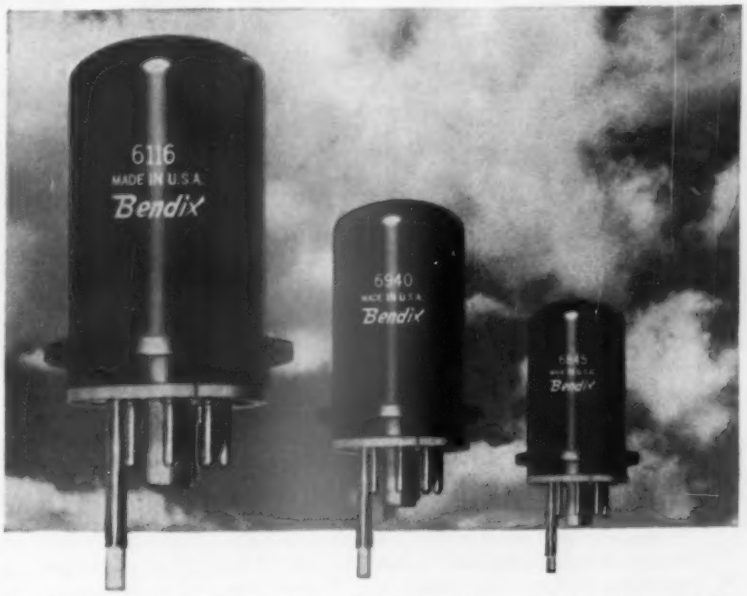
Aeroflot's largest air-drop containers are of the "pneumatic-rubber" type. They consist of three or four inflated rings held together side-by-side with netting. Automobile or airplane tire-inner tubes are often used.

Open ends of this "package" are closed with inflated soccer or volleyball bladders. Aeroflot says this type of container can be assembled at any airport in several minutes and can be used for up to 100 air drops. Water bottles en-

BENDIX RUGGEDIZED REFLEX KLYSTRONS WITH THERMAL TUNING

The 6116/TE-39 Klystron tube combines ruggedized construction and *thermal tuning*. The combination provides a desirable tube for use in airborne radar and similar applications. Ruggedization makes possible a frequency jitter of less than ± 1.3 MC . . . at vibration levels up to 10 G at 50 cps. Thermal tuning provides a twofold advantage. It permits tuning the tube over its entire operating frequency remotely without mechanical means—and the tube can be repeatedly cycled throughout its tuning range without damage or deterioration.

These Reflex Klystrons are but one example of how Bendix Red Bank technology can help you meet specialized tube needs. For information on these tubes . . . and on backward-wave oscillators and traveling-wave tubes . . . write RED BANK DIVISION, BENDIX AVIATION CORPORATION, EATONTOWN, NEW JERSEY.



The 6116/TE-39 ruggedized Reflex Klystron thermally tunes a band of 8500 to 9660 MC by means of a diode within the vacuum envelope. Tuning speed over the required frequency range is 0.7 seconds min. to 3.0 seconds max.

The 6940/TE-58 is identical to the 6116, but has special characteristics limiting spectrum width and spectrum continuity under adverse load conditions.

The 6845/TE-59 is similar in electrical and mechanical characteristics to the 6116 but may be operated under pulsed conditions with minimum frequency modulation.

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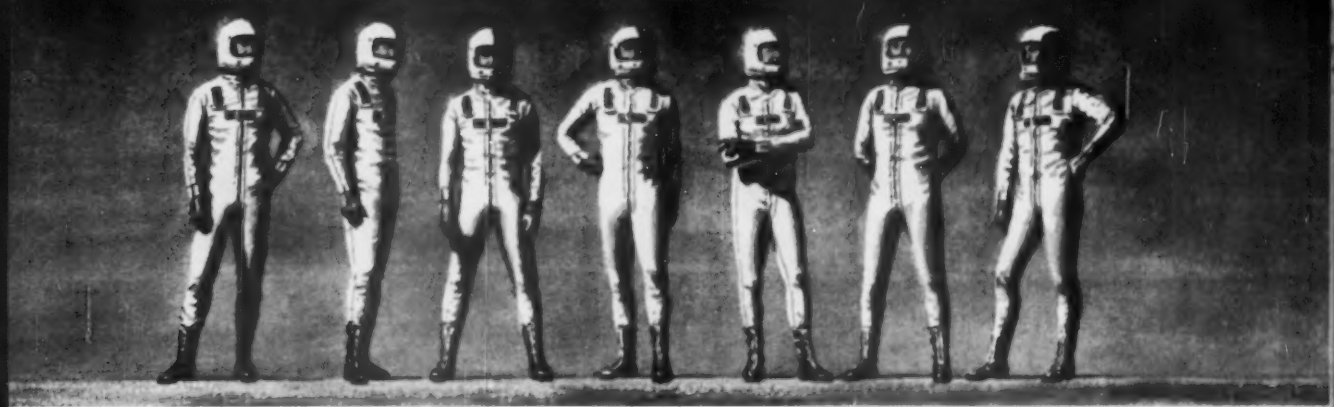

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ELECTRONICS ENGINEERS: IT'S TIME TO SET YOUR COURSE WITH THE WORLD LEADER IN CONTINUOUS WAVE DOPPLER NAVIGATION SYSTEMS

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The farther man departs from Earth, the more important becomes the reliability of the doppler principle, and the brighter the future of all who work with the leader in this field.

There are immediate openings with Ryan in two of Southern California's most progressive communities, San Diego and Torrance, noted for ideal climate, fine housing and outstanding educational facilities. If you've even considered making a change, for full particulars, send your resume or write for a brochure to Ryan Electronics, Department 4, 5650 Kearney Mesa Road, San Diego 11, California.

RYAN ELECTRONICS

DIVISION OF RYAN AERONAUTICAL COMPANY, TORRANCE, CALIFORNIA, SAN DIEGO, CALIFORNIA

Helicopter Taxi Service Operates in Los Angeles

Non-scheduled helicopter taxi service is being operated between downtown Los Angeles and Los Angeles International Airport by Helicabs, Inc., a charter operator. Helicopters are two Bell 47J Rangers leased from National Helicopter Service, a charter operator. The 47Js are flown by National pilots. Additional helicopters will be made available from National's fleet to meet Helicabs' requirements. The service, flown only during daylight hours, costs $11 a person one way between the Pacific Electric Building helistop (AW Dec. 21, p. 34) and the airport. The trip takes 9 min. A downtown Helicabs' site will be operating in Pasadena within 90 days.

Skylane during the week-end event.

High altitude charts (levels above 24,000 ft.) for general aviation pilots are now available from Jeppesen & Co., Denver, Colo.

Deere & Co., Moline, Ill., has purchased a Douglas DC-3 modified for passenger hauling and in-flight office work by Remmert-Werner, Inc., St. Louis. Plane has been cleaned aerodynamically to provide a 205 mph. cruise speed. Tom Roche is Deere's chief pilot.

Long-playing record entitled "On Course, On the Glide Path" is a new instructional aid for private pilots interested in airway navigation. The record, priced at $5.98, is being offered by Gunnell Aviation, Inc., Santa Monica.

Grumman Aircraft Engineering Corp.'s Ag-Cat has been certificated by Federal Aviation Agency for a 300-hp. Lycoming or a 450-hp. Pratt & Whitney engine. The agricultural biplane is normally powered by a 220-hp. Continental engine. Ten Ag-Cats (AW May 12, 1958, p. 113) were sold in 1959. Base price for the spray version is $18,000; combination spray-dust model costs $18,800.

closed in such packages have been dropped on ice from a height of 3,300 ft. without breaking.

Most rugged type of air-drop package used by the Russian airline is a sponge rubber sphere with space inside for ampoules, medicines or livestock vaccines. Containers such as this have been reused as many as 300 times.

PRIVATE LINES

December deliveries of U. S. business and utility aircraft totaled 734 units with manufacturers' net billing total value of $11,289,000, compared with 588 units shipped in December, 1959, with a value of $9,350,000. Total 1959 deliveries came to 7,689 units with a retail value of approximately $170 million, compared with 6,414 aircraft having a retail value of about $135 million a year ago. Factory shipments in 1959; 996 twin-engine business planes.

Production of Silvaire two-place private planes is expected to reach two per day by the end of 1960's first quarter. Silvaire Aircraft Co., Ft. Collins, Colo., will introduce new models this spring.

First Cessna dealer show in the New York area was termed a success after the dealer, Teterboro Aircraft Service, Inc., Teterboro, N. J., wrote orders for two Model 310Ds, a Model 210 and a

PROBLEMATICAL RECREATIONS 2

To stimulate his son in the pursuit of partial differential equations, a math professor offered to pay him $8 for every equation correctly solved and to fine him $5 for every incorrect solution. At the end of 26 problems, neither owed any money to the other. How many did the boy solve correctly?

—Adapted from Clavius, 1608

ANSWER TO LAST WEEK'S PROBLEM: The conditions of the problem permit a second degree difference equation in two variables which can be factored. With the three sets of two solutions, taking into account the given conditions, viz., number of articles purchased equal to the average cost and the inequality of 63 rupees more spent by each husband than wife, one can associate each couple. Hence the answer is $A-C_1$, $B-B_1$, and $C-A_1$.

LITTON INDUSTRIES
Electronic Equipments Div.
Beverly Hills, California

Our carrier-based tactical data system is the smallest, most complete, transistorized digital system of its type. Engineers interested in creating circuit designs for digital and analog computers and associated input-output devices for these systems are invited to write Mr. Ron McNiven.

HILLER 12E performance and capabilities can be increased with kits for installation of four-place cabin, dual carburetors, high compression pistons and turbo-supercharged engine. Hiller 12E is shown lifting a lightplane in a demonstration at Caracas, Venezuela.

Kits Extend Hiller 12E Capability

Palo Alto, Calif.—Hovering at 20,000 ft. at maximum gross weight will be possible in the Hiller UH-12E with installation of a turbo-supercharger kit. Other modifications, also available in kit form, are designed for payload and performance increases as part of the planned growth potential built into the helicopter, according to Hiller Aircraft Corp.

Increasing seating capacity from three to four is possible by installation of a cabin replacement kit.

Weight Increase

Gross weight increase caused by the modification is 50 lb. No modification is required to the power or drive system. However, a slight sacrifice in performance results—hover out of ground effect (HOGE) decreases from 5,060 ft. to 4,500 ft. and hover in ground effect (HIGE) decreases from 8,950 ft. to 8,450 ft. Service ceiling drops from 14,000 ft. to 13,600 ft.

Performance loss due to the added weight of the modification can be offset by increasing horsepower through the addition of:

• **Dual carburetors.** Adding 15 hp. while increasing gross weight by 10 lb., dual carburetion will boost HOGE altitude by 1,150 ft. HIGE will increase by 1,100 ft., and service ceiling increases 1,600 ft.

• **High compression pistons.** Requiring 100/130 octane fuel, rather than 80/87 now used, the new pistons add 2 lb. to the gross weight while increasing HOGE by 1,650 ft., HIGE by 1,500 ft. and service ceiling by 2,000 ft.

• **Combination of dual** carburetion and high compression pistons. Result is an increase of 2,800 ft. in HOGE, increase of 2,600 ft. and service ceiling boost of 2,900 ft.

• **Turbo-supercharged** Lycoming VO-540 engine. Hiller says that this new engine, certification of which is expected soon, will develop its full 305 hp. to at least 20,000 ft. Thus, HOGE, HIGE and service ceiling all will be the same—20,000 ft.

Performance of a basic Hiller UH-12-E at 2,700 lb. gross weight is HOGE 5,050 ft., HIGE 8,950 ft., service ceiling 14,000 ft. Maximum speed, vertical and forward rates of climb are not affected by the modifications.

47Js Fly Schedules in St. Louis

Scheduled helicopter service connecting St. Louis Municipal Airport with midtown and downtown helistops began this month with Bell 47J Rangers.

Mississippi Valley Helicopters, Inc., will operate 40 flights a day, Monday through Friday, using two 47Js on each trip. All seats are reserved.

The company will operate a courtesy car from the 18th St. helistop in downtown St. Louis to eight hotel and commercial district points.

Single-passenger fare between the airport and Forest Park, midway between downtown and the airport, is $4. Fare between downtown St. Louis and the airport is $5. Courtesy car service is included in the fare.

The trip from the airport to Forest Park takes 5 min.; from the airport to downtown, elapsed time is 9 min.

The first flight in the day leaves the airport at 8 a. m. The last flight departs downtown at 9.43 p. m., arriving at the airport at 9:54.

Mississippi Valley Helicopters was established a year ago and began charter service (AW Nov. 16, p. 91) with one helicopter. In its first year of operation it flew more than 6,000 passengers a total of 100,000 mi. It now operates four helicopters.

WHO'S WHERE

(*Continued from page 23*)

Changes

J. P. McNamara, manager of the newly formed Liquid Propulsion Operations of Rocketdyne, a division of North American Aviation, Inc., Canoga Park, Calif. **E. A. Wright** succeeds Mr. McNamara as manager of the Neosho, Mo., plant. Also: **Ross Clark,** Canoga plant manager.

James W. Hatch, general manager of the Downey, Calif., plant of Ex-Cell-O Corp., Detroit, Mich.

Joseph J. Dysart, manager of commercial programs, Douglas Aircraft Co., Inc., Santa Monica, Calif.

Mrs. Charlotte Franklin, international public relations directress, Varig Airlines, Inc.

Dr. W. Wai Chao, chief of research, Vickers, Inc., division of Sperry Rand Corp., Detroit, Mich.

Raymond T. Zwack, manager of industrial products and systems development, the Liquidometer Corp., Long Island City, N. Y.

Gene R. Peterson, general manager, General Electric Co.'s Ordnance Department, Pittsfield, Mass.

Bernard H. Paiewonsky, senior research engineer responsible for studies of the motion and control of space vehicles, Aeronautical Research Associates of Princeton, Inc., Princeton, N. J.

Jack Womack, flight operations manager, the Garrett Corp., Los Angeles, Calif.

Hal F. Halsted, head of Atlantic Research Corp.'s newly formed Space Vehicles Group, Pasadena, Calif. Other appointments to the new group: **David Benun,** senior engineer; **John W. Reed, Jr.,** responsible for pre-contract engineering; **Joseph Balrush,** responsible for administrative functions.

Gilbert H. Lee, commercial director, British Overseas Airways Corp.

Dr. Donald F. Mitchell has been appointed a bioastronautics scientist in the Astro Systems and Research Laboratories of Northrop Corp.'s Norair Division, Hawthorne, Calif.

Brig. Gen. David L. Van Syckle (USA, ret.), a director of the newly established Office of Foreign Operations, Aerojet-General Corp., Azusa, Calif.

Bruce Johnson, manufacturing manager, Helipot Division of Beckman Instruments, Inc., Fullerton, Calif.

Bryan F. LaPlante, director of The Mitre Corp.'s Washington, D. C., office.

Dr. Robert W. Bass, chief scientist, Aerospace Division of Aeronca Manufacturing Corp., Baltimore, Md.

Boeing Airplane Co., Seattle, Wash., has announced the following staff appointments on the Dyna-Soar boost-glide vehicle project: **William E. Ramsden,** assistant program manager; **Benson Hamlin,** (Step 1) system manager; **Paul Sanders,** customer requirements manager; **Ellis Levin,** systems growth manager; **Robert F. Watt,** program planning and control manager.

Stephen E. Gregoire, director of engineering, Scintilla Division of Bendix Aviation Corp., Sidney, N. Y.

A New Role for The Mature Scientist

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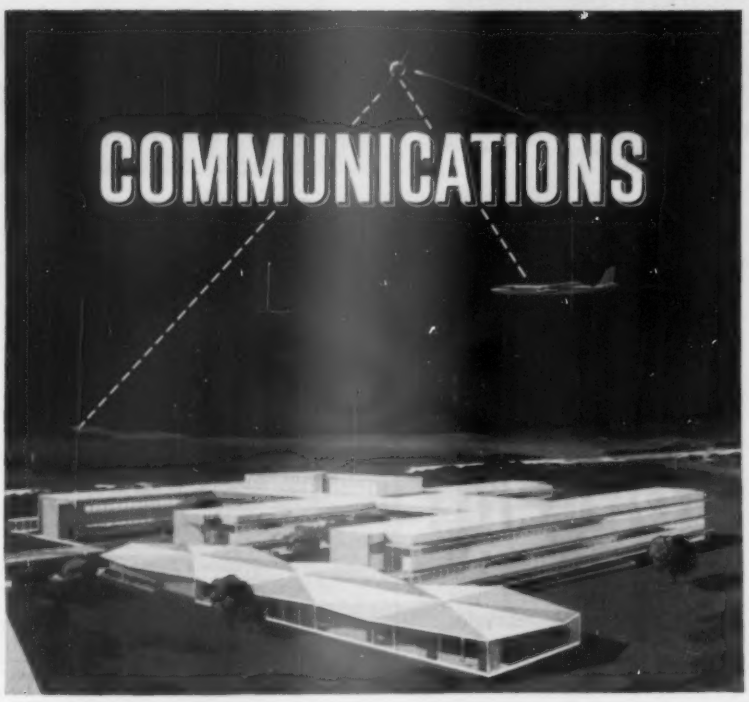

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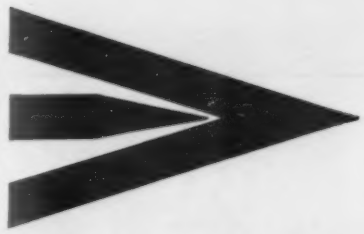
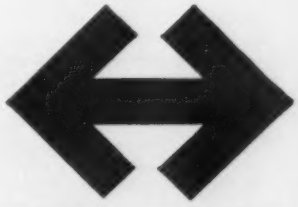


AERODYNAMICS

Exceptional opportunities now exist at Boeing-Wichita for the aerodynamics engineer whose training and experience in airframes or missiles qualifies him to conduct advanced studies of preliminary design vehicles, ranging from subsonic to hypersonic ranges. In our long-range Product Design program he will find challenging assignments, ample room for professional growth and advancement in a creative environment and equitable salary.



PROPULSION

The propulsion engineer with a degree and solid experience will find the opportunity he has been seeking in a position now open at Boeing-Wichita. His work will involve studies of subsonic and supersonic air inlets, engine exit nozzles and diffusers, ducted fans and thrust augmentation devices and all-phase testing to increase thrust and efficiency of propulsion systems in new product proposals. He will take part in a long-range Product Design program that offers challenging opportunities for professional and personal advancement, and full recognition of his accomplishments.

You will like Mid-American living. For immediate action, contact Mr. Melvin Vobach, Dept. AWB-2, Boeing Airplane Company, Wichita 1, Kansas.

BOEING WICHITA

LETTERS

Mr. Brooks Replies

I have read with interest your editorial on "The Space Debate" in the Feb. 1 issue (p. 11) of your magazine. While I cannot agree with the position you have taken with regard to the Committee on Science and Astronautics, I recognize that every man is entitled to his opinion.

I would like to point out, however, what I consider to be the achievements of the Committee and express the hope that you will, in all fairness, accord these expressions the same prominence in your periodical as your editorial.

The Committee is scarcely one year old. We have made mistakes and I would be the first to concede this, but we are also proud of the progress we have made during our brief existence. We are forging ahead in virgin territory. The precedents are few and often it is difficult to determine what road to travel when there are so many that stretch before us.

New Committee

But considering the difficulties that lie in the path of a new committee operating in a new field, we feel that our score has been impressive. I doubt that there is any committee of Congress which has probed deeper into its field of operations than this Committee.

During the eight months of the first session of this Congress, the Committee acted upon the first regular annual budget of the civilian space agency, as well as other legislation, conducted 30 investigations, issued 21 reports, held 146 hearings, heard 447 witnesses, and took several million words of testimony.

Among the major subjects investigated by the Committee were research in chemical, biological and radiological warfare; satellites for world communication; dissemination of scientific information; space propulsion; the ground-cushion phenomenon; the status of missile and space programs; U. S. policy on the control and use of outer space; nuclear explosions in space; scientific manpower and education; and basic scientific and astronautic research in the Department of Defense. The Committee has also been engaged in a continuing study of the contracts and contract procedures of the National Aeronautics and Space Administration.

Advisory Panel

This Committee has also established a Science Advisory Panel to aid the Committee in its work. The panel is composed of some 12 to 15 of the nation's most outstanding scientists and engineers—men who represent the great colleges and scientific institutions of our country and whose names receive world-wide recognition, such as Dr. James Van Allen of Iowa State University, Dr. Fred L. Whipple of Harvard, Dr. Clifford C. Furnas of the University of Buffalo, and others. These panel members will give this Committee and the country the benefit of their thinking on the problems that face us in the fields of basic and applied science, in space technology and in space exploration.

In addition to this, the Committee has available numerous other outstanding scientists on a consultative basis.

While I regret the opinions you expressed concerning me personally, they are not important other than that they embody misconceptions concerning the role played by the Chairman. I hardly think my colleagues look upon me as dictatorial. I have been called many things in my life, some complimentary and some otherwise, but no one heretofore has deigned to characterize me as a dictator.

While I plead guilty to being, on the whole, "technically untutored," as you describe it, I doubt whether any among the other 536 members of Congress could lay claim to being more professionally competent in this admittedly difficult and largely uncharted field. We try to do the best we can with our admittedly limited capabilities.

Knowing as we do that members of Congress are, generally speaking, not experts in science and in space technology and exploration, this Committee has tried to gather together a competent and experienced staff. We feel that we have done so. It is headed by a career congressional employe who is regarded as one of the foremost professional staff experts on Capitol Hill, with more than 11 years' experience here.

Veteran Members

Another member of the staff has had 16 years of congressional experience. Most of the staff is composed of veteran members of the staff of the Select Committee on Astronautics and Space Exploration which preceded this Committee and worked with House Majority Leader John McCormack, its chairman, in drawing up the Space Act of 1958 which created NASA. This staff is a highly professional, competent and non-political group which won the praise of Mr. McCormack and the other members of the Select Committee, both Republicans and Democrats.

This staff has been available at all times to furnish to the members of our Committee the benefit of their years of experience. On occasion, pertinent background information, including questions, have been provided members to assist them in the performance of their official duties. I am baffled by your accusation that I have forbidden staff members "to provide questions to other committee members." Their instructions at all times have been to cooperate with the members to the fullest possible degree.

It is true that the staff is not composed of scientists and technicians. This is a legislative committee and not a scientific body. However, there are several highly competent men on the staff with broad technical knowledge and the Committee implements the work of these technical experts by employing scientists and engineers as special consultants on a per diem basis. No effort is overlooked to supply the Committee with the best technical advice possible.

Four Subcommittees

I am afraid you have been misinformed regarding the work done by subcommittees. The Committee has four permanent subcommittees and they have been implemented by special subcommittees where this has been determined necessary. The subcommittees last year handled the major piece of legislation to come before the Committee, the 1960 fiscal year authorization for NASA. Subcommittees made an intensive study of the research and development activities of the military services and a special subcommittee is now engaged in scrutinizing the Space Act with a view to possible revision of its patent provisions.

Last year, you also editorialized concerning this Committee in a manner which was not entirely complimentary. I extended to you, at the time, a personal invitation to meet with me and talk over the problems and obstacles facing this Committee and the Congress in advancing America's position in space technology and space exploration, fields in which we are both interested. You failed to accept my offer.

It has always been my wish, and that of the Committee, to avail ourselves of the help and advice of others who have the same interest we have, namely, to place the United States where it belongs, in the forefront in the race to explore the great unknown that stretches into infinity about us.

I realize, as does this Committee, the importance of this and the fact that we have only scratched the surface. This Committee lays no claim to being the sole repository of knowledge in this complicated and important field. We welcome the help of scientists, engineers, technologists, yes, even editors.

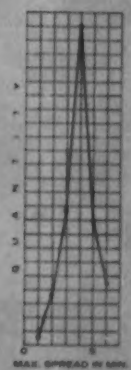
My door is always open to members of the press and I welcome you, as I do all members of the Fourth Estate, to my office to talk with me about the common problems that face this Committee and the nation in the exploration of outer space.

OVERTON BROOKS
Chairman
Committee on Science and Astronautics
House of Representatives
Washington, D. C.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

SYNCHROS *for* GYRO PLATFORMS

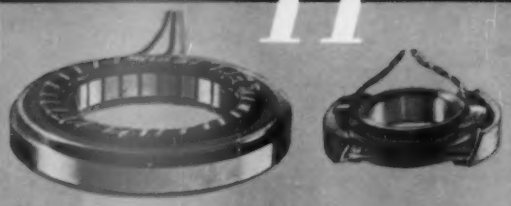
by cppc



8′ max. error spread Synchro for Gyro Pick-Off

The SG-17- and ST-17- type pancake synchros (SG-18- and ST-18- with housings) are our most standard line for gyro pick-off applications.

These units have been manufactured in large quantity and are readily available for prototype breadboarding. The high accuracies shown on the left are obtainable in standard 26v or 115v units.

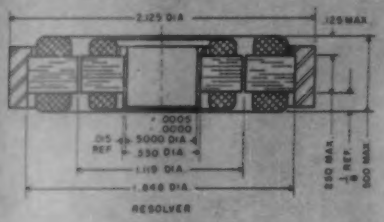


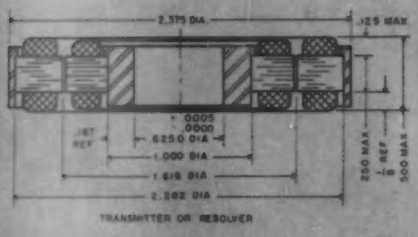
Custom Designed Pancakes

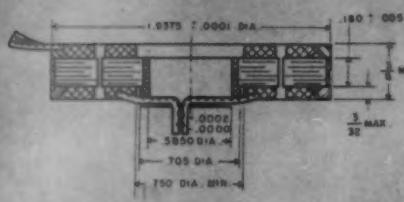
CPPC has developed a number of special pancakes (drawings below) with relatively large bores and narrow stack heights.

Means have been devised to minimize error due to clamping pressures on these thin units.

Special accuracies have been maintained where required. Let us know your needs.







Pancake Resolver for Gimbal Mounting

Clifton Precision produces special pancake resolvers for direct gimbal mounting. They were developed for use in cascaded amplifierless resolver systems and have been trimmed for 10K input impedance, 0° phase shift and a constant transformation ratio, with temperature, at 900cy. Accuracies of 4′, perpendicularities of 3′ and nulls of 1mv/v of output or less can be held.

Special techniques maintain concentricity between rotor and stator — thus reducing difficulties commonly encountered in gimbal mountings.

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